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# The Marine Engineer

## AND NAVAL ARCHITECT.

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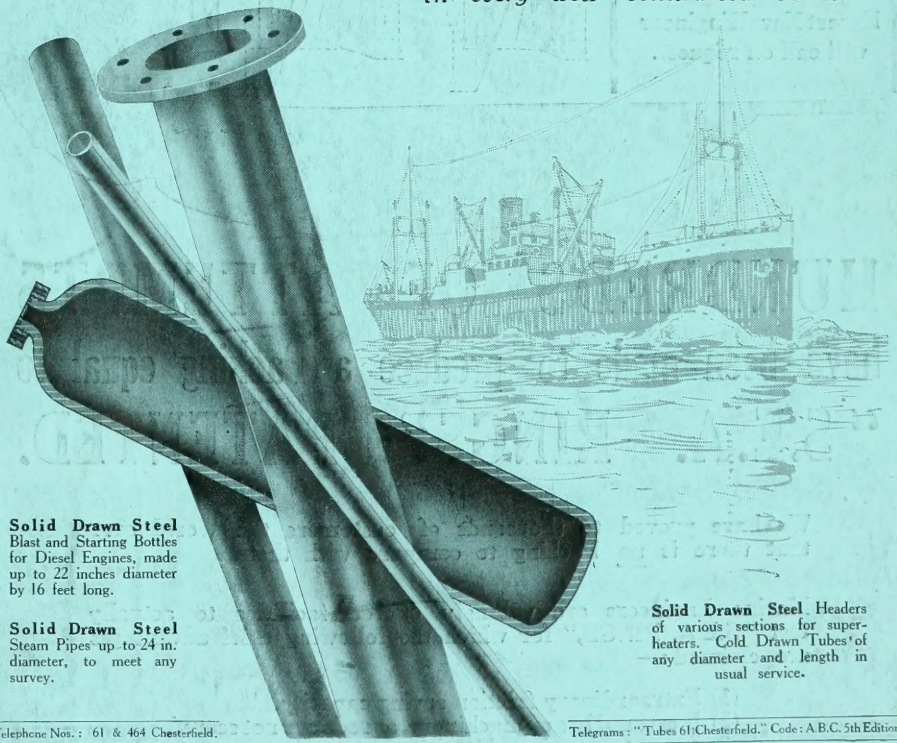

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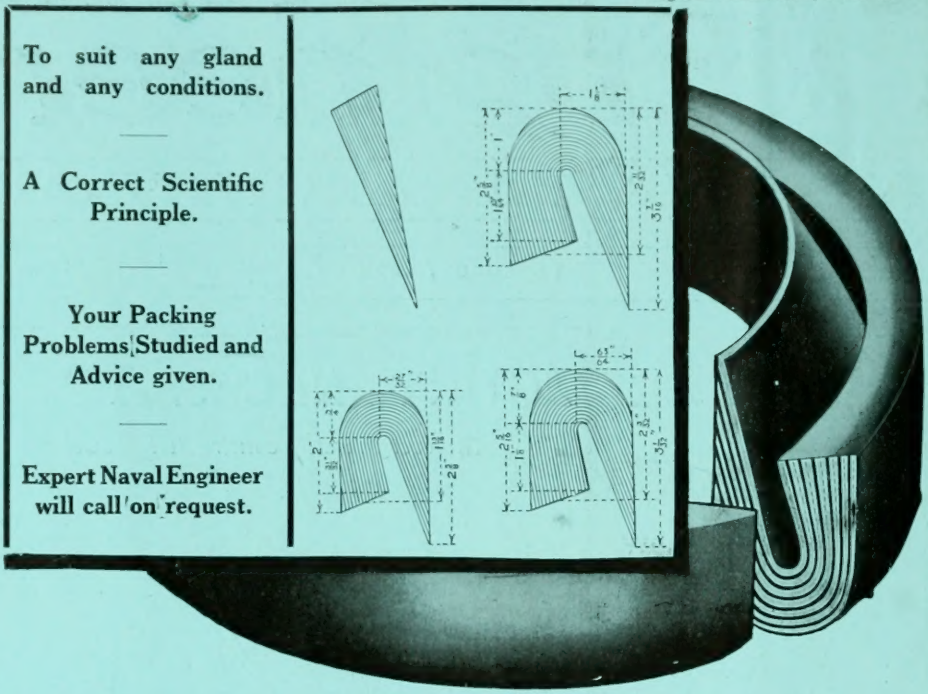

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# The Marine Engineer AND NAVAL ARCHITECT.

*A Practical Journal for all Concerned in the Design Construction and Maintenance of*

MECHANICALLY PROPELLED SHIPS — MARINE ENGINEERING WORKS
DIESEL AND OTHER OIL ENGINES — WELDING & MECHANICAL REPAIRS
AUXILIARIES & REFRIGERATION — CARGO HANDLING APPLIANCES

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The Editor will be glad to consider original articles and paragraphs on all subjects indicated by the title. Short practical articles based on the sender's own experience and illustrated by photographs or drawings are desired.

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Mr. Alan Crombie has been promoted to Chief Engineer of the River Wear Commission, Sunderland.

Mr. Frank Edward Smith, O.B.E., F.R.S., Director of Scientific Research at the Admiralty, has had the C.B.E. (Order of the British Empire, Civil Division) conferred upon him.

Sir Vincent L. Raven, K.B.E., M.Inst.C.E., M.I.M.E., late Chief Mechanical Engineer of the North Eastern Railway Company, has joined the Board of the Metropolitan-Vickers Electrical Co. Limited.

The death occurred at Harrow, on January 8, of Sir William Crump, head of the firm of William A. Crump & Son, Solicitors, of Leadenhall Street, who have a large maritime and mercantile practice in the City. Sir William Crump was seventy-three years of age.

Geheimer Marinebaurat a. D. August Müller, who is well known from his long association with the Keusetliche Werft Kiel in warship construction, and who was for ten years instructor in Naval Architecture at the Marine Akademie, died at Lubeck recently, aged 55 years.

Direktor Hermann Frahm, Technical Director of the Blohm & Voss concern, has had the honorary degree of Doctor of Engineering conferred upon him by the Technische Hochschule Hannover, in recognition of his scientific and practical contributions to shipbuilding and engine construction.

At the December meeting of the Diesel Engine Users' Association, Mr. A. E. Farrow, A.M.I.E.E., Engineer to the Windsor Electrical Installation Co. Limited, was elected President for the ensuing year, and Mr. Percy Still, M.I.E.E., M.I.Pet.Tech., was re-elected Honorary Secretary.

Mr. G. W. Richardson McCammon, M.B.E., R.C.N.C., has been appointed by the Admiralty to be Chief Ship-Overseer, at Birkenhead, for the construction of the new capital ship, the keel of which was laid last month. Mr. McCammon went from the Chatham Dockyard, where he had been a leading member of the Construction Staff for the past 10 years.

Mr. C. P. Martin, a director of C. A. Parsons & Co. Limited, has been made the recipient of several valuable presents by his colleagues on the staff of the firm's Heaton works and the staff of the Turbinia Works, Wallsend, on the occasion of his retirement after 30 years' service. He served his apprenticeship at the Heaton Works, and for a good many years has been the company's representative in London.

Captain M. Chris. James, son of Mr. M. C. James, the managing director of the Mercantile Dry Dock Company Limited, Jarrow, has been appointed general manager of that undertaking, and has also been elected a member of the directorate. He has been assistant to his father for 17 years. During the war Captain James served in France with the Royal Engineers. Subsequently he acted as Deputy Superintendent of Ship Repairs on the North-East Coast, and when the war terminated he received a letter of warm appreciation from Lord Pirrie.

Mr. H. A. Butt has been appointed to superintend the construction of the new Southampton floating dock, which is being built by Sir W. G. Armstrong, Whitworth & Co. Limited, at their Walker Naval Yard. Mr. Butt, who was for some time assistant to the shipyard manager at Cammell Laird's, will act on behalf of the London & South Western Railway Company, the owners of the dock. Since leaving Birkenhead he has represented the British Government as an Assistant Director of the National Shipyards, at Chepstow, and later the Canadian authorities, as Inspector of Shipbuilding, in Western Canada.

Mr. A. D. Mearns has relinquished his position as General Manager of the Cunard Steam Ship Company. He commenced his business career with the Mersey Docks and Harbour Board, and joined the Cunard Company as Secretary in August, 1898. In 1906 he was appointed sub-manager to Mr. A. P. Moorhouse, in addition to his secretarial work, and on the death of that gentleman, in 1907, he was appointed general manager. Early in 1918 he became a director of the Cunard Company, and he then occupied the dual position up to his retirement. Mr. Mearns still retains his seat on the Board. Mr. S. J. Lister and Mr. A. C. F. Henderson have been appointed Joint General Managers.

Mr. F. C. Mullens, the new President of the Bristol Channel Engineers & Ship-Repairers Employers' Association, is General Manager and Secretary of the Port Talbot Graving Dock & Shipbuilding Co. Limited. Mr. Mullens has also been connected with South Wales ship-repairing during the whole of his commercial career, for he started with Mordey, Carney & Co. Limited, at Newport, in 1887; and continued with that firm in various capacities until 1899, when he joined the Port Talbot Graving Dock & Shipbuilding Co. Limited, at its inception, as Secretary. In 1903 he was also made General Manager of the company. In 1913 the new president of the Ship-Repairers' Association was president of the Port Talbot Chamber of Commerce.

# EDITORIAL.

## THE MARINE ENGINEERING SITUATION.

MUCH has been heard during recent months about the most suitable type of propelling machinery for cargo vessels. The owner who contemplates additions to his fleet has the advantage—or disadvantage—of a veritable mass of opinion and advice, all of which seeks to give him the most economical and efficient propulsive installation. In the light of all this, then, we feel that it is not devoid of interest to the practical as well as to the theoretical engineer to examine the recently-published statistics issued by Lloyd's Register of Shipping dealing with the number of steamships and motor ships commenced and launched during the past quarter.

| Country. | 1st Quarter. | | 2nd Quarter. | | 3rd Quarter. | | 4th Quarter. | |
|---|---|---|---|---|---|---|---|---|
| | No. | Tonnage. | No. | Tonnage. | No. | Tonnage. | No. | Tonnage. |
| United Kingdom— | | | | | | | | |
| Steamers | 18 | 49,208 | 12 | 37,177 | 30 | 66,908 | 64 | 199,307 |
| Motor vessels | 1 | 100 | 5 | 810 | 3 | 15,200 | 5 | 30,260 |
| Denmark— | | | | | | | | |
| Steamers | 1 | 550 | 1 | 1,050 | 1 | 960 | 2 | 2,060 |
| Motor vessels | — | — | 1 | 2,925 | 3 | 7,605 | 4 | 10,610 |
| France— | | | | | | | | |
| Steamers | 6 | 29,587 | 11 | 23,360 | 2 | 5,800 | 2 | 14,800 |
| Motor vessels | — | — | — | — | — | — | 9 | 3,900 |
| Holland— | | | | | | | | |
| Steamers | 1 | 2,000 | 3 | 12,100 | — | — | 5 | 4,400 |
| Motor vessels | — | — | 1 | 5,250 | — | — | — | — |
| Italy— | | | | | | | | |
| Steamers | 1 | 5,300 | 2 | 200 | — | — | 2 | 7,300 |
| Motor vessels | — | — | — | — | — | — | — | — |
| Japan— | | | | | | | | |
| Steamers | 1 | 3,800 | 3 | 13,990 | 10 | 16,120 | 12 | 12,234 |
| Motor vessels | 1 | 310 | — | — | — | — | — | — |
| Norway— | | | | | | | | |
| Steamers | — | — | 3 | 3,389 | 5 | 6,689 | 3 | 4,744 |
| Motor vessels | — | — | — | — | — | — | — | — |
| Sweden— | | | | | | | | |
| Steamers | — | — | — | — | 1 | 850 | 1 | 1,450 |
| Motor vessels | — | — | 1 | 130 | 2 | 13,260 | — | — |
| America— | | | | | | | | |
| Steamers | 6 | 10,400 | 8 | 39,200 | 10 | 48,400 | 10 | 42,350 |
| Motor vessels | 3 | 800 | 2 | 1,498 | — | — | 1 | 1,000 |

Taking all countries, the total steamer and motor tonnages on which work was commenced during each of the four quarters of the present year were as follows :—

| | 1st Quarter. | 2nd Quarter. | 3rd Quarter. | 4th Quarter. |
|---|---|---|---|---|
| | Tons. | Tons. | Tons. | Tons. |
| Steam | 114,725 | 133,416 | 148,297 | 291,995 |
| Motor | 1,310 | 10,866 | 36,875 | 41,870 |
| Motorship percentage | 1·17 | 8·15 | 24·8 | 14·3 |

A careful study of the figures shows that the steam propelled vessel is by no means a back number yet. In the United Kingdom, for instance, during the last quarter, 234,831 tons of steam shipping was launched as against 24,627 tons of motor shipping, whilst 64 vessels, with a total gross tonnage of 199,307 were commenced during the quarter, as against five motor vessels with a total gross tonnage of 30,260. Corresponding figures for the preceding quarter show 30 steam vessels with a total gross tonnage of 66,908, as against 3 motor vessels with a total gross tonnage of 15,200. If we turn to the Scandinavian countries who were amongst the earliest to recognise the possibilities of the motor ship we find that Denmark, for instance, commenced during the last quarter only two steamships with a total gross tonnage of 2,060, as against four motor ships with a total gross tonnage of 10,610.

The table of ships launched, however, shows that, as far as numbers are concerned, the tables are turned, since there were four steamships, with a total gross register tonnage of only 4,249, as against two motor ships averaging only 292 tons apiece. For the last three quarters, American figures have shown a margin in favour of the steam-propelled vessel. This is also the case with Japan which has commenced only one motor vessel (gross tonnage 310) during the past year. Considering these figures collectively then, what may we deduce therefrom ? The steam-driven unit still seems to be largely in the majority, and it would be interesting to enlarge, would space permit, upon these steam statistics and to divide them up into their groups :—single and double-reduction geared turbines, triple and quadruple expansion engines, and steam-electric drive. Trouble has been experienced with double-reduction gearing, which seems to have tempted some shipowners back to the reciprocating engine, and the steam-electric drive does not seem to have made much headway in this country. The Diesel-electric drive is to be introduced in some vessels this year and their progress will be watched with considerable interest. The motor ship may be considered still as at an early stage of development. It is, however, merely a question of time before it forges ahead in all branches of construction. The types of engine are numerous, an amount of research work is being carried out, and the majority of leading technical societies are devoting a great deal of careful attention to the problem of the motor ship, the recent symposium dealing with the main types of internal-combustion engines, arranged by the North-East Coast Institution of Engineers and Shipbuilders, being a sufficiently useful illustration of this. Whilst, therefore, it will be at once patent that the steamship is still in the majority, it is at the same time clear that the motor ship is one from which we shall hear great things in the future.

## SPEED.

THE shipbuilding community is slow to recognise some of its most useful friends. It was pointed out at a recent meeting of the North-East Coast Institution of Engineers and Shipbuilders, that the industry was chiefly indebted to corrosion and naval warfare, for the brief spasms of prosperity that it occasionally enjoyed. Another friend in disguise—and so well disguised as frequently to be mistaken for an enemy—is the resistance of water to the motion of a ship, and the peculiar fact that this resistance tends to increase as the square or even higher powers of the speed. If ship resistance were less, higher speeds would be practicable, and proportionally fewer ships would be required. Conversely, the lower the average speed of the world's shipping, the larger the number of ships necessary to cope with a given volume of trade. Assuming that this mean speed is 10 knots, which is perhaps a somewhat high figure, then if this could be reduced to 9 knots, a virtual increase of no less than 10 per cent. in the total tonnage afloat would be involved.

High speeds, in addition to having this depressing effect on the shipbuilding industry, are not necessarily advantageous to the shipowner. It has been remarked more than once that when freight rates are low the most profitable speeds are considerably reduced. There is a tendency (partly psychological) for the bulk of new tonnage to be ordered when the freight rates are high, and the shipping industry enjoying abnormal prosperity. Such vessels are liable to be designed for unduly high speeds, speeds which may give a maximum return under the current conditions, but which, when normal, or below normal, freight rates obtain, place the vessels at an economic disadvantage, compared with the slow-speed ship. There is no doubt that many of the United States Shipping Board vessels suffer from this effect. Not only does high speed

involve greatly increased fuel weight and cost, but, in addition, it is usually associated with fine form. If it is desired to run this vessel at lower speeds, she is burdened with possibly several hundred tons of superfluous machinery weight, and a further virtual loss of deadweight is incurred owing to the fact that the block coefficient is now too low. When the shipowner is endeavouring to arrive at the most suitable speed and form for a given vessel, he should remember that for the ordinary steamer :—

1. On a given voyage, fuel weight and cost increase as the square of the speed.

2. Machinery weight and cost increase as the cube of the speed.

3. Wages and accommodation costs for firemen increase roughly as the cube of the speed.

4. Number of cargoes carried in the year, and hence freight earnings, increase at less than the first power of the speed, since the time spent in port is not affected. A large proportion of vessels spend at least half their time in port, loading, discharging, &c.

It has been contended that a merchant ship attains maximum efficiency when the time spent at sea is very large compared with the time spent in port, the idea being that the vessel is only usefully employed as a *ship* when actually carrying cargo at sea. The general principle is no doubt perfectly sound, and provides an additional economic reason in favour of the slow-speed vessel. Mr. John Anderson deals very ably with this aspect of speed in his paper on " Most Suitable Sizes and Speeds for General Cargo Ships." (Transactions I.N.A., 1918). He measures the " time " efficiency of a merchant ship by the ratio of the time spent at sea to the total time taken on the round voyage. Of course, this efficiency value can be increased by making longer voyages, or by more rapid cargo handling, bunkering, &c. That increased " time " efficiency is also obtained by reducing the sea speed may appear somewhat unnatural, but it is a point which should be borne in mind when the praises of the high-speed merchant ship are being sung.

From an economic point of view, of course, high sea speeds are strongly to be discouraged. In land transport, resistance to motion is almost entirely independent of the speed, except for the air resistance, which varies as the square of the relative velocity. Thus, assuming machinery of constant efficiency, the fuel consumption on a given length of journey, should be constant for reasonable variations in the average speed, and the weight of machinery should vary rougly as the first power of the speed. At sea on the other hand, an increase of 50 per cent. in speed means in general an increase in fuel consumption on a given voyage, of at least 125 per cent., and an increase in machinery weight required of about 240 per cent. Thus Nature imposes a severe handicap on sea transport which is only mitigated by the very much smaller intensity of fluid friction (which may here be taken to include wave and eddy resistances) as compared with solid friction, provided of course that the speed is not excessive. It is in the interests of civilisation, and in particular of those nations whose continued economic prosperity depends largely on the natural deposits of fuel in their possession, to discourage unnecessary fuel expenditure.

It must be remembered that a nation whose sea-going tonnage is of low speed is at a disadvantage in case of war. The probability of a vessel being attacked and sunk on any voyage obviously increases with the number of days spent at sea on that voyage, and thus the value of speed in time of war cannot be overestimated. When vessels sail in convoys under escort, however, a capacity for high speed in a given vessel, or vessels, may be useless, since the speed of a convoy cannot exceed the maximum speed of the slowest vessel in the convoy.

In the case of warships, speed has a very special tactical and strategic value. But whilst the average speed of our fighting fleet appears to be getting higher and higher, and no doubt for eminently sound reasons, yet high speed in a particular vessel can only be obtained at the expense of armament and protection. As in the case of the merchant ship, it is a question of compromise, for the one between fuel economy and time economy, and for the other, between gun power and speed.

## FUEL INJECTION IN DIESEL CYLINDERS.

FOR very many reasons the Diesel engine is recognised as being particularly suitable for the propulsion of merchant ships, and yet, despite all these undoubted advantages, we are still a long way from seeing the Diesel engine widely installed for this purpose. There are, it would seem, two main reasons which mitigate against its extended adoption on board ship, and they are its comparative unreliability and the short life of certain of its essential parts. One of the most important details of the Diesel engine, and the one which is, perhaps, the most fruitful source of failure, is the fuel-injection system. It is well known that in the Diesel cycle of operation the fuel is forced into the cylinder where, as a result of the heat of compression of the air already in the cylinder, it automatically ignites, the heat thus liberated being responsible for the work done during the succeeding stroke of the piston. It is obvious that, in order to ensure complete and even combustion, the fuel must be finely divided as it enters the cylinder, and, moreover, that it must become thoroughly mixed, after it enters, with the air already in the cylinder. There are thus two conditions essential to efficient fuel injection, namely, atomisation and turbulence, and in order to ensure that these conditions shall be fulfilled, the fuel is forced into the cylinder through a fuel valve so constructed that it breaks up the fuel into a fine spray and delivers it into the cylinder with such a motion that it is spread throughout the combustion space and becomes intimately mixed with the air that is necessary for its combustion. The fuel used on ships propelled by Diesel engines is usually thick residual oil, *i.e.*, natural petroleum as it issues from the ground after the lighter and more valuable fractions, such as petrol and paraffin have been distilled off. The resulting fuel oil is a viscous black fluid at ordinary atmospheric temperatures, and steps have to be taken to ensure that it shall be thoroughly atomised at the fuel valve. Two systems have been devised for ensuring this ; first, the blast-air system in which, as its name implies, a blast of air under pressure is employed to force the fuel into the cylinder against the compression pressure therein, and at the same time to break up the fuel into a fine spray. The second is the solid injection system in which the fuel oil under pressure is forced through a valve so arranged that it is broken up into fine particles before entering the cylinder. An examination of the various types of Diesel engine already manufactured shows that the air-blast system is more generally used than is the solid system, although both systems are employed by different well-known engine builders, and each possess advantages which cannot be claimed by the other. For instance, the use of air for conveying the fuel into the cylinder has the undoubted advantage that it ensures that the tiny particles of fuel shall be surrounded with air required for combustion, but against this has to be set the fact that the sudden expansion of the air on entering the cylinder, due to the fall of pressure, lowers the temperature of the air in the vicinity of the fuel, thus tending to retard combustion. This of course is avoided in the solid system and as a result it is found that the maximum compression pressure which must be attained in the cylinder of an engine with air-blast injection is higher than with the other system. Each system, in fact, has its advantages and its disadvantages, and it is only by patient experiment and research, and by a careful study of the practical running of engines in everyday service, that the means of overcoming the disadvantages will be discovered.

# BOOKS FOR THE MARINE ENGINEER AND NAVAL ARCHITECT.

**Brief Reviews of Recent Publications.**

**Transactions of the Institution of Naval Architects, 1922.** Issued by the Institution and edited by R. W. Dana, O.B.E., M.Inst.C.E., Secretary to the Institution, at 5, Adelphi Terrace, W.C.2.

The Transactions contain the usual reports of the Spring Meetings held in London, and of the Summer Meetings held in Paris; there are also some written contributions to discussions on papers, which have been received since the original papers were read.

**General List of Merchant Shipping, 1922-23.** Published by the Bureau Veritas International Register of Shipping, 31, Rue d'Offrément, Paris, and 155, Fenchurch Street, E.C. 11 in. × 12 in. × 3½ in.

The Repertoire-General is in its 53rd year of publication, having been issued yearly since 1870. The work now appears in one volume consisting of four parts, the sections treated being as follows:—

(*a*) Steamers and motor vessels.
(*b*) Vessels having auxiliary mechanical propulsion.
(*c*) Sailing vessels.
(*d*) A miscellaneous section containing vessels whose names have been changed, vessels with compound names, and a list of builders and owners.

It is interesting to note that the volume, "which already gives very useful technical details concerning the vessels entered, will receive other interesting improvements, now under consideration."

**Mechanical World Year Book, 1923.** Published by Emmott & Co. Limited, 65, King Street, Manchester. 4 in. × 6½ in. × 1¼ in. 215 pp. Price 1s. 6d. net.

Another of our engineering annuals, representing by no means the minimum point on the curve of efficiency plotted to a base of books produced. The practical engineer will find here a mass of useful information, from notes on strength of materials to decimal equivalents of fractions, from steam engine constructional details to tabulated volumes of spheres for given diameters. The book is well known, and we feel sure that the majority of engineers have a copy in their ready-use library.

**Munro's Marine Engineers' Annual Pocket Log and Diary.** Published by James Munro & Co. Limited, Glasgow. 5 in. × 7 in. × ¼ in. Price 2s. 6d. net.

A great deal of valuable information is contained in this annual. There is an interesting article entitled "Work and Progress in 1922," marred only by the reproductions of some marine paintings of well-known liners whose proportions are as Brobdingnagian as those of the surrounding craft are Lilliputian. Those to whom speed records appeal will find a short section dealing with speed and ocean-steaming records. An article dealing with the Scott-Still marine engine is reproduced from the "Marine Engineer Officers' Magazine," and a paper dealing with the open-fronted surface ignition engine is reprinted from the Transactions of the Institute of Marine Engineers. Viewed generally, the book is one which we feel justified in bringing to the notice of practical engineers.

**The Diesel Engine.** By A. Orton, A.M.I.Mech.E. Pitman's Technical Primers. London: Sir Isaac Pitman & Sons Limited, Parker Street, Kingsway, W.C.2. Price 2s. 6d. net.

This little book is one of a number of similar books of a semi-popular nature which Pitman's are showering upon the technical world, presumably with the idea that the technical world is sorely in need of such. The author deals with a very important subject, important to both marine and mechanical engineers, and considering the enormous field upon which he has embarked, he appears to have given us a remarkably comprehensive review in the small space at his disposal. The book should prove very valuable to those who are desirous of obtaining an elementary knowledge of Diesel engines, and the attached bibliography is a very valuable feature of the volume.

**Mechanical Engineering Detail Tables.** By J. P. Ross. London: Sir Isaac Pitman & Sons Limited, Parker Street, Kingsway, W.C.2. 7½ in. × 7 in. × ¾ in. 197 pages. Price 7s. 6d. net.

This book has been compiled from tables, some of which "have appeared in published form scattered among the text-books, periodicals, and transactions of engineering societies." The author also states that "although a certain amount of collected tables appears in year books and pocket books, it can be asserted confidently that such a complete collection has not hitherto existed." The object of the book is "to supply the designer of machinery with a ready means of ascertaining the proportions of a number of machine details, which are, in a large degree, common to most classes of mechanical engineering."

**Mechanical Testing.** (Vol. II.) By R. G. Batson, M.Inst.C.E., M.I.Mech.E., and J. H. Hyde, A.M.Inst.C.E., M.I.A.E., A.M.I.Mech.E. London: Chapman & Hall Limited, 11, Henrietta Street, W.C.2. The D.U. Technical Series. 6 in. × 8¾ in. × 1½ in. 25s. net.

Technical men are doubtless familiar with Vol. I of this excellent work. Vol. II deals with the testing of prime movers, machines, structures and engineering apparatus. It is well-arranged and contains valuable plates, diagrams and curves. There is a particularly useful chapter dealing with columns and struts, in which the derivation of Rankine's formula is discussed. Chapter XXI is both appropriate and important, containing as it does an account of tests carried out on aircraft models. This is a book we would certainly recommend to marine engineers.

## TRADE PUBLICATIONS.

*Allen Barton & Co. Limited*, Providence Foundry and Engine Works, St. Helens Junction, Lancs., have issued a booklet which gives illustrations of the various types of winches and capstans manufactured by them. The publication is prefaced by a specification of their standard horizontal steam winch.

*Ships, their Builders and the Kromhout Marine Oil Engine.*—This is a very interesting little handbook, published by Perman & Co. Limited, 82-83, Fenchurch Street, E.C.3, containing many details and statistics of Kromhout Marine Oil Engines, photographs of the various types of engine, and a remarkably comprehensive series of illustrations showing the multifarious types of craft in which these engines are installed.

*Air Compressors and Vacuum Pumps.*—We have received a copy of the 1923 booklet of air compressors from the Globe Pneumatic & Engineering Company Limited. Their productions include portable plants on rail or road wheels, semi-portable plants on channels, sets driven by electric motor through gears or by belt, and petrol and paraffin outfits. The booklet contains many interesting and useful details.

# LETTERS TO THE EDITOR.

## MARINE REDUCTION GEARING.

To The Editor of
The Marine Engineer and Naval Architect.

Your editorial of the December issue on Reduction Gearing is of considerable interest.

I have had some experience of this form of propulsion and its defects, and must say I grow somewhat tired of so much x-chasing in connection with the troubles of gearing. Given good materials and suitably designed teeth, the one thing necessary is accurate workmanship. I feel sure that the want of the latter is responsible for most of the troubles. It is not always realised how important and how difficult it is to obtain dead-true alignment. In the simplest design of double-reduction gearing with high-pressure and low-pressure turbines, there are five vertical and two horizontal planes.

The vertical planes must be precisely at right angles to the horizontal, and the vertical and the horizontal planes must be respectively precisely parallel.

How often is such accuracy attained ?

It appears that Thorne and Calderwood are on the right track when they recommend flexible shafts, but they are mistaken as to the reason for such introduction.

They need them, not for the purpose of minimising the amplitude and effect of vibrations, but for minimising the effect of inaccurate workmanship.

" P.T.B."

## "THE BATTLE OF THE TALENTS."

To the Editor of
The Marine Engineer and Naval Architect.

Your editorial article, " The Battle of the Talents," published recently, is of considerable interest, and I agree with quite a lot of its sentiment. It seems nevertheless to raise a few controversial points. Why, for instance, do you separate the technical from the practical ? The whole trend of development and education is to endow one and the same person with as much practice and technique as possible. Theory is not juggling with symbols but primarily the *raison-d'être* of practice. If practice says one thing and our theory another, then we do not understand our practice and must re-examine our "theoretical" diagnosis. Solution will *not* be a compromise. It will be obtained when a sufficient number of men are both thoroughly practical and thoroughly technical.

" DUNELM."

## ENGAGEMENTS FOR FEBRUARY.

Institute of Marine Engineers.—Meetings at the Institute, the Minories, Tower Hill, London, E., on Tuesday, February 13, at 6.30 p.m. " Internal Combustion and Economy," by Tage D. Madsen. Tuesday, February 27, " Auxiliary Machinery," by Engr.-Com. R. Beeman, C.M.G., R.N.

Liverpool Engineering Society.—Meetings at Royal Institution Colquitt Street, on Wednesday, February 7, at 8 p.m. " Electric Propulsion of Ships," by R. S. Johnson. On Wednesday, February 21, " High-Ratio and High-Speed Transmission Gears," by J. J. Clark, M.Eng., A.M.I.Mech.E.

North-East Coast Institution of Engineers and Shipbuilders.—Meeting in Lecture Theatre of Literary and Philosophical Society, Westgate Road, Newcastle-on-Tyne, on Friday, February 16, at 7.30 p.m., " A Review of Turbine Failures and their Causes." by Professor A. L. Mellanby, D.Sc. (Associate Member), and W. Kerr, A.R.T.C. On Friday, February 23, annual dinner. On Friday, March 2, " Measured Mile Trials," by G. S. Baker (Member).

Institution of Mechanical Engineers.—Annual dinner of *Midland Branch* on Tuesday, February 6 ; and on Thursday, March 1, meeting in Birmingham University, Edmund Street, at 7.30 p.m., " Inspection of Engineering Material," by R. D. Summerfield (Associate Member). On Monday, February 26, meeting of *Graduates' Section, London.* Annual lecture, " Photo-Elastimetric Researches on Mechanical Engineering Problems," by Professor E. G. Coker, D.Sc., F.R.S. (Member).

Manchester Association of Engineers.—Meeting in Memorial Hall, Albert Square, Manchester, on Friday, February 9, at 7 p.m. Smoking concert.—Friday, February 23, " Workshop Efficiency," by G. E. Bailey, M.I.Mech.E. (Member). *Student Members' Section.* Meeting in Chemical Lecture Theatre, Municipal College of Technology, Sackville Street, Manchester, on Friday, February 16, at 7.30 p.m. " The Application of A.C. and D.C. Motors in Industrial Situations," by R. Johnston (Student Member).—Friday, March 2, " The Part Played by the Civil Engineers in Hydro-Electric Schemes," by G. S. Coleman, D.Sc., Assoc.M.Inst.C.E. (College of Technology).

Institute of Metals.—Meeting of *London Local Section* at Institute of Marine Engineers, the Minories, Tower Hill, London, E., on Thursday, February 8, at 8 p.m. " The Investigation of the Constitution of Alloys," by Miss M. L. V. Gayler, M.Sc.—On Tuesday, February 13, meeting of *North-East Coast Local Section* in Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. Discussion.—On Tuesday, February 13, meeting of *Scottish Local Section* in Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, at 7.30 p.m. " Some Phases of Lead Manufacture," by J. A. Sillars. —On Friday, February 9, meeting of *Sheffield Local Section* in Mappin Hall, University of Sheffield, St. George's Square, at 7.30 p.m. Symposium on " Stainless and Non-Corrodible Alloys."

## DIESEL AUXILIARIES.

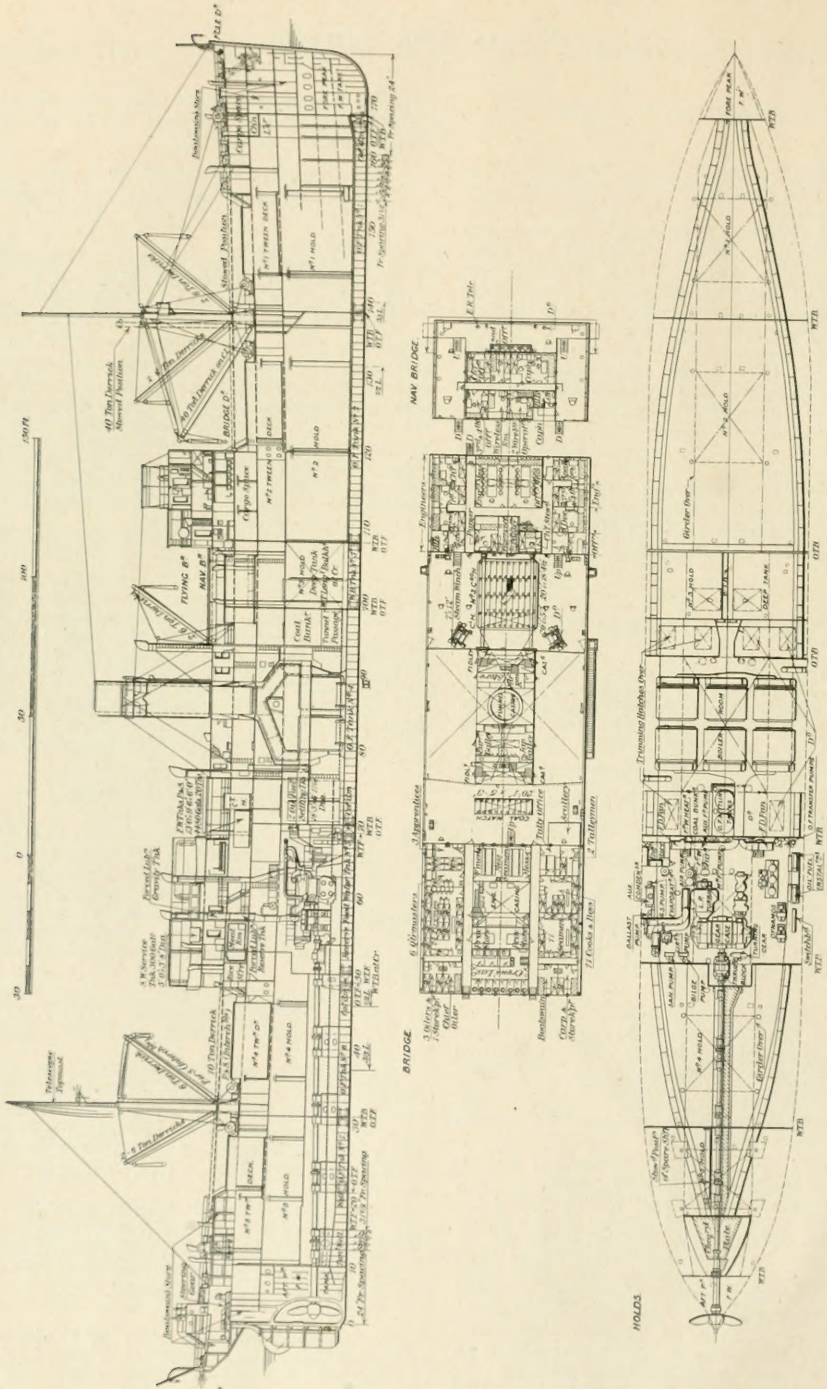
We illustrate on page 60, two auxiliary engines built by Burmeister & Wain Limited, as part of the propelling plant of 6,000 and 3,000 i.h.p. respectively, which they have under construction for two cargo liners for the Ocean Steam Ship Company Limited, of Liverpool. For the large ship there are four auxiliary engines, each being of the three-cylindered type direct-coupled to a dynamo of 100-k.w. capacity, at 220 volt, and provided on its forward end with a multi-stage air compressor for supplying injection air. Each of the engines is capable of developing continuously 150 b.h.p. at 300 r.p.m. The left-hand photograph shows one of these engines on the test bed.

The reason for the especially large auxiliary machinery is the large amount of current required for electric light, refrigerating plant, &c., the ship also being intended for passengers.

The other photograph shows the manœuvring compressor ; this latter is separately driven by an electric motor, and the compressor is of the multi-stage type, pumping up to 25 atmospheres.

All the auxiliary machinery is electrically driven, and will consist of two separately-driven cooling water pumps, two lubricating oil pumps, one daily supply and transfer pump, and a steam-driven emergency air compressor. In the smaller ship there are three auxiliary engines.

A booklet setting forth the " Standard Conditions for the Design and Construction of Water-Tube Marine Boilers," has been issued by the Board of Trade. Copies are obtainable from H.M. Stationery Office, Imperial House, Kingsway, W.C.2. Post free, 3d.




S.S. "London Maru" and "Paris Maru," Profile as Fitted. Plan of Bridges and Holds.

# TWO 10,000-TON DEADWEIGHT CARGO VESSELS FOR JAPANESE OWNERS.

"London Maru" and "Paris Maru"—General Particulars—Hull Details—Machinery—Boilers—O.F. Installation.

Many of the fundamental ideas of Japanese shipping and shipbuilding were undoubtedly based upon British methods; so much so in fact, that whereas even 20 years ago Japan was dependent almost entirely upon foreign and more especially upon British shipyards, both for her Navy and for her Mercantile Marine, at the present day she is able to meet almost all her own demands in this direction. It is worthy of note, however, that her owners have not forgotten British shipyards entirely. The two vessels which we here have under review are amongst the largest vessels built in this country for Japan for some years past. The vessels were built by Cammell, Laird & Co. Limited, Birkenhead, to the order of M. Samuel & Co. Limited, the London Agents of the owners, the Osaka Shosen Kaisha. The work was carried out under the supervision of Flannery, Baggallay & Johnson Limited, Consulting Engineers and Naval Architects. The *Paris Maru* was successfully tried at sea on December 2 last, and a mean speed of 14½ knots was attained.

## General Particulars.

The vessels are single-screw steel cargo steamers, having complete main and upper decks, poop, bridge, forecastle, flying and navigating bridges. They have been built under special survey of the British Corporation and the Imperial Japanese Marine Corporation, to Class B.S.* The principal dimensions are as follows:—

| | |
|---|---|
| Length b.p. .... .... .... .... | 450 ft. |
| Breadth, moulded .... .... .... | 56 ft. 6 in. |
| Depth, moulded to bridge dk. .... .... | 43 ft. 3 in. |
| Depth, moulded to upper dk. .... .... | 35 ft. 3 in. |
| Length, beam ratio . . | $\frac{L}{B}$ = 11·5. |
| G.R.T. .... .... .... .... .... | 7,201 tons. |
| N.R.T. .... .... .... .... .... | 4,422 tons. |
| Displacement .... .... .... .... | 15,500 tons. |

Deadweight, 10,000 tons, at which a speed of 14 knots was stipulated in the design, on coal or oil fuel.

There are eight watertight bulkheads, six of which extend to the upper deck, and five cargo holds—three forward and two abaft of amidships, as will be seen from the accompanying general arrangement plan. No. 3 hold, it is interesting to note, is constructed so as to form a deep tank, and is adapted for the carriage of cargo, reserve coal, oil fuel or water ballast. Cargo can be also carried in the forecastle, on the upper deck amidships, and on the main deck above the engine room; the fore peak and aft peak are adapted for the carriage of fresh water, which is also carried in two large tanks on the upper deck amidships. Cellular double bottoms are fitted fore and aft, and are arranged to carry oil fuel, water ballast and feed water.

## Cargo Handling Apparatus.

There are two steel masts with telescopic top mast to suit Manchester Ship Canal requirements, for which reason the funnel top is also made portable. Eleven steel derricks are fitted for working the cargo—one 40-ton, one 10-ton and nine 6-ton—and there are 10 steam winches. It will thus be seen that provision for rapid loading and discharging has been made, should the vessel be in a port where the shore cargo-handling appliances are out of working order or in an inefficient state of operation. There is a steam windlass fitted on the forecastle for working cables and a steam winch for warping purposes on the poop.

## Accommodation.

All accommodation is situated amidships, the officers being berthed at the aft end and the crew at the fore end of the bridge erection. Quarters for both officers and crew seems to be ample and commodious. There are two galleys, situated immediately abaft the funnel, one for Japanese, and the other for Europeans. Storage is provided amidships for provisions, which are also carried in the poop. Underneath the crew-space at the aft end of the bridge erection, *i.e.*, on the upper deck amidships, insulated meat and vegetable rooms for crew's use have been fitted, the refrigerating machinery being placed in the engine-casing at the level of the main deck.

## Machinery Space.

The single screw is driven by a set of Parsons turbines, one high-pressure, one intermediate-pressure, and one low-pressure turbine, through double-reduction gearing, and astern turbines are incorporated in the intermediate-pressure and low-pressure casings. Under average working conditions the installation develops a shaft horse-power of about 6,250, the corresponding revolutions per minute of the main shaft being about 90. Power developed when going astern is about 60 per cent. that developed for ahead running. The gearing on the gear wheels is of the double-helical type, and the main gear wheels have cast-iron centres with forged steel rims shrunk on to the wheels and secured by nickel steel pins. There are flexible couplings of the Robertson Fairfield type between the turbines and the gearing, the governing of the former being carried out by means of a cut-out governor working in conjunction with the forced-lubrication system which shuts off steam from the high-pressure ahead turbine. Governors are fitted to each turbine shaft with connections to the throttle value controlling the high-pressure steam. The condenser fitted to the installation is capable of maintaining a 28-in. vacuum with the turbines working at full power, the temperature of sea water 80° Fahr., and the barometer at 30 in.

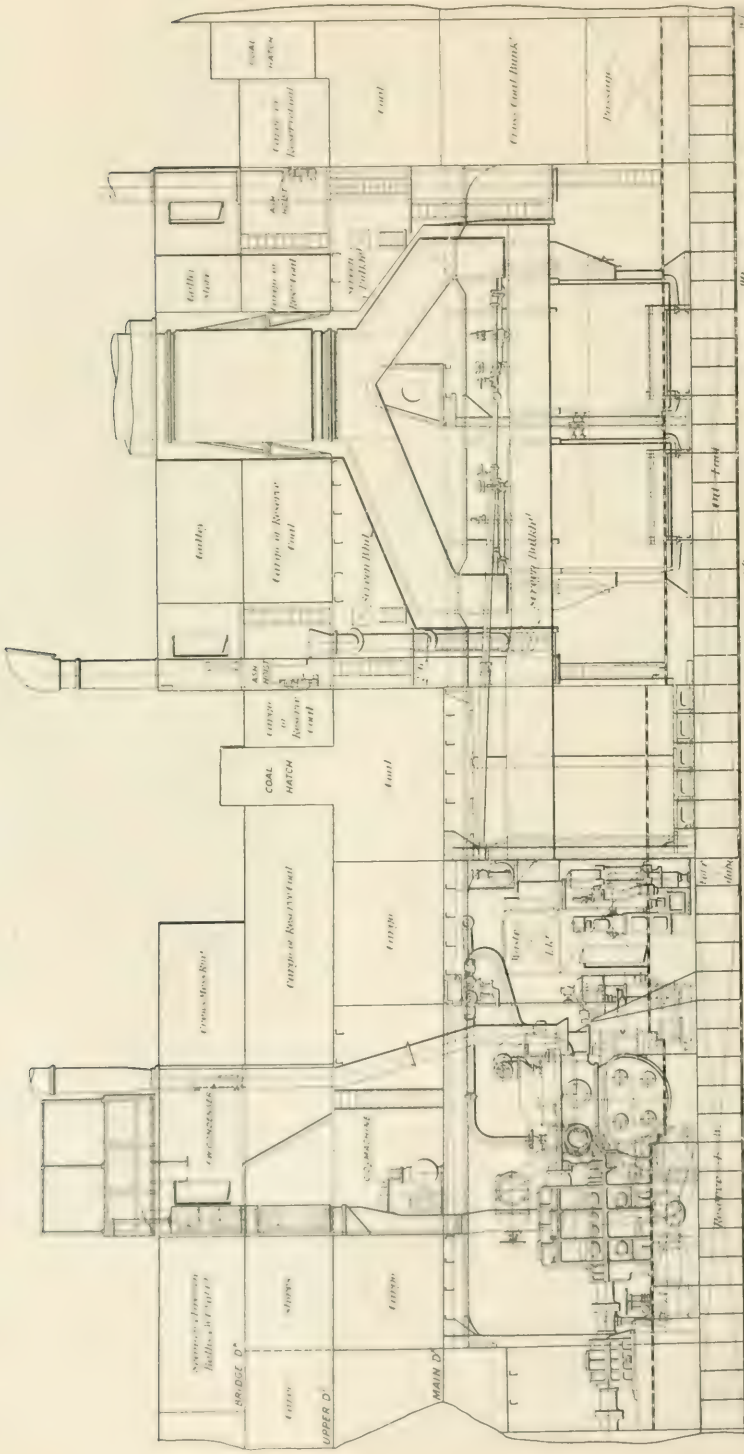
The circulating pump is driven by a high-speed enclosed lubrication engine, running at about 300 r.p.m. It is constructed to draw from the sea and from the main bilge injection, and to discharge to the main and auxiliary condensers and to the oil coolers, and thence overboard.

One set of dual independent air pumps is fitted and designed to meet the requirements of the vacuum, which it maintains at 24 strokes per minute. Two direct-acting feed pumps are fitted, each of which has cast-iron ends, and there is a duplex type ballast pump of about 200 tons capacity, which draws from all ballast tanks, peak, bilges and the sea, and discharges to the main and auxiliary condensers, the deck, the oil cooler, and overboard. There is a 40-ton evaporator, fed by an automatic regulator, and fitted with an automatic brine ejector.

The auxiliary feed pump is a direct-acting pump, gun metal lined, and having a cast-iron water end; it feeds one single-ended boiler for harbour use. The auxiliary condenser is of the cylindrical non-vacuum type, having 700 sq. ft. and a cast-iron body. The circulating water is controlled by the ballast pump or by the main circulating pump. The auxiliary condenser drains into a control tank, which is provided with a connection from which the auxiliary feed pump can draw.

## Boilers.

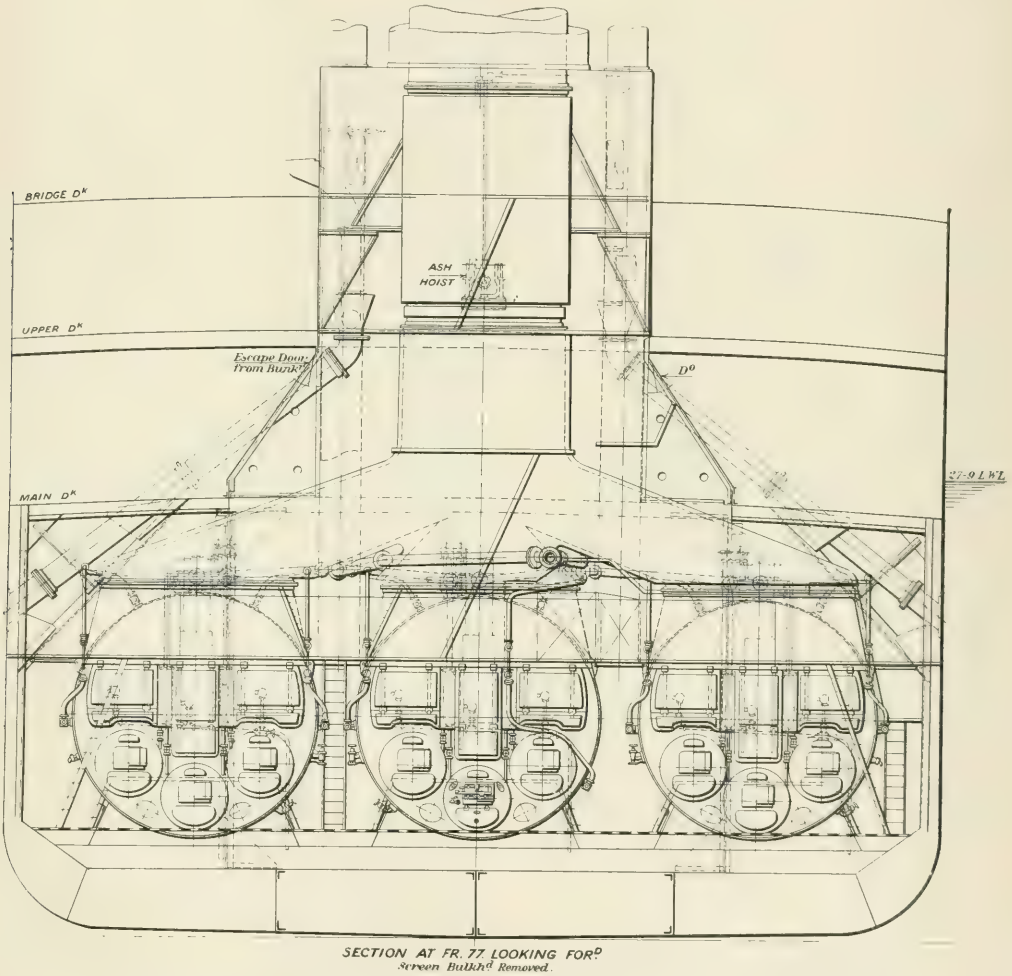
There are six single-ended cylindrical boilers, which are arranged to burn either coal or oil, the arrangements being of




"London Maru" and "Paris Maru." Elevation through Engine Room and Boiler Space, looking to Port.

the Wallsend-Howden type; the boilers have forced draught working on the Howden system. Each boiler is 12 ft. long and has a diameter of 14 ft. 6 ins. The total heating surface is about 14,356 sq. ft., the total grate area about 360 sq. ft., and the working pressure is about 200 lbs. per square inch. Each boiler has three corrugated furnaces of the Morison

pump, having the usual air vessel and relief valve, and one oil-fuel heater, with steaming-out connections. Each plant is independent, can deal with the fuel for all boilers at full power, and is so arranged as to draw from the oil-fuel supply tank through a duplex suction strainer, and discharge it through the strainer and heater to the burners.




**"London Maru" and "Paris Maru." Section through Boiler Room, looking Forward.**

type, which are withdrawable. There are Schmidt superheaters giving steam to the turbines with a superheat of 100° Fahr., which is not used by the auxiliary machinery.

### Oil Fuel System.

The installation for burning the liquid fuel is on the Wallsend-Howden system; there are two transfer pumps for dealing with the double bottom oil and for pumping the oil bilges and delivering back to the oil supply. There are two sets of pumping and heating plant, each set consisting of one oil-fuel

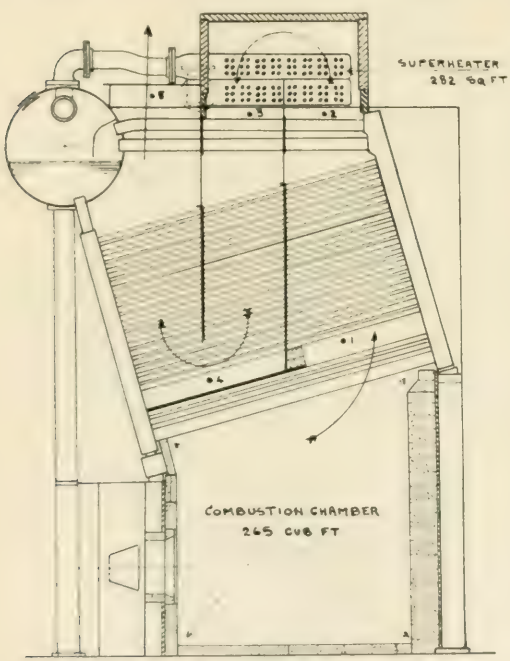
### Workshop, &c.

The workshop and store is well-fitted up and contains, amongst other usual appliances, a small motor-driven lathe. There is an ash-hoist engine, 4 in. by 5 in., fitted in each stokehold, as well as hand-lifting gear. For generating electricity there are two 8-kw. steam-driven dynamos, fitted in the engine room, giving current at 100 volts; the vessels are electrically lighted throughout, and are equipped with a wireless telegraphy outfit.

# HIGH RATES OF HEAT TRANSMISSION.

**Importance of Knowledge of Heat Transmission—Analysis of and Deductions from Boiler Trials.**

During the discussion on Mr. A. S. Watkinson's paper on the Relative Advantages of the Four-Stroke or Two-Stroke internal-combustion engine, read before the Liverpool Engineering Society in December last, Professor W. H. Watkinson of Liverpool University, made some very interesting references to extreme rates of heat flow encountered in the cases of certain Diesel engines. The whole subject of heat transmission through cylinder liners and covers, or through piston crowns, is a matter of very pressing importance at the present time,




Babcock & Wilcox Boiler, showing position at which Temperatures were taken

because the stresses induced by the rapid flow of heat there through during the combustion period has, in the past, been responsible for most of the principal mechanical troubles which [illegible] the development of the internal-combustion engine, and its future evolution, particularly as regards increased power per cylinder, is still largely restricted by this influence.

Professor Watkinson quoted the case of experiments which have been made with certain German submarine engines—presumably captured ones, although he did not specifically state so—in which the heat flow through the cylinder liners and covers ran from 11,000 and 32,000 B.Th.U. per hour [illegible] and 67,400 respectively, and he also mentioned the case of a two-cycle engine, rated at 140 b.h.p. per cylinder [illegible] in which the maximum flux in the liner was 20,500 and in the cylinder cover 55,000 B.Th.U. per square foot per hour. Such cover trans-[illegible] appear to be at least [illegible] practical comparative figures of heat transmissions obtained from other forms of engine, would seem to be called for, so that some criterion of the quantity of heat-flow met with in other branches of engineering work can be brought forward as an independent guide to the relative severity of the passage of heat through metal, and one's mind naturally turns to boiler practice in order to ascertain what amounts of heat transmission per square foot are actually encountered in ordinary working and under exceptional conditions of forcing, and also to what extent these compare with the very high figures quoted by Professor Watkinson.

## Comparisons—Cylinder Liners and Boilers.

The conditions, however, as between internal-combustion cylinder liners and the boiler combustion chamber or furnace plating and the tube surfaces are very dissimilar both as regards the material employed and the nature of the application of the heat, the former being composed of relatively thick cast-iron subject to intermittent heating, and the latter of relatively (or in the case of a water tube boiler of very) thin steel under constant high temperature. But when, on glancing at records of transmission of thermal units, one finds, for instance, such wide variations as an *average* of only 5,400 B.Th.U. per square foot per hour of total boiler heating surface in the boilers of a large cross-Atlantic steamer working with Howden's forced draught at an efficiency of 82·3 per cent. and a consumption of 20·6 lbs. of coal per square foot of grate per hour, and the published results of the trials made by Professor Watkinson himself on the Camellaird-Fullagar opposed-piston oil engine, in which 3·6 per cent. of the total heat supplied at full power is stated to have passed into the piston cooling water, giving a transmission of nearly 23,000 B.T.U. per square foot, one is apt to get the impression at first sight that the localised temperature effect in the internal-combustion cylinder is relatively enormous, whereas, in point of fact, it is not really so. In the case of the R.M.S. *Saxonia*—for that is the vessel referred to—the transmission rate applies to the whole boiler, and is, of course, but a small proportion of the rate through the furnace or combustion chamber walls. Unfortunately, records of boiler transmissions subdivided into stages are very scarce. The most prolific records available on the subject are probably those of locomotive boiler trials in which consumptions considerably exceeding 100 lbs. of coal per square foot of grate are often found. Readings of temperatures taken at various points in a big marine boiler are very limiten indeed, and without concomitant records of evaporatiod and consumption are virtually worthless, as was seen in the case of a tantalising paper read at one of the Northern Societies' meetings some years ago, and which contained the former but not the latter information. Very useful data on combustion chamber transmissions might easily have been provided in this case, but as neither fuel burnt, nor water evaporated, was stated, the measurement of a mere figure of 2,200° Fahr. in one place, 1,700° in another and 600° at the tube outlet ends told one practically nothing. Mr. Harold Yarrow has published some interesting figures of the temperature fall across the rows of tubes in a Yarrow boiler, showing the very large drop which occurs in the furnace bows, but, again, the paucity of information did not admit of its being employed for the purpose of making deductions other than as regards those to which the data related.

## Information from Boiler Trials.

Some most useful information, however, on the subject of exceptionally high transmission rates is to be found by analysis

of the results of certain trials of a Babcock & Wilcox boiler, fired with oil fuel at various rates of combustion, and which are published in the very excellent catalogue of marine boilers issued by that firm. The data given is exceptionally complete, and besides including full figures of fuel consumption, evaporation and efficiency, also provides the draught and temperature readings at various points in the boiler. These enable very valuable deductions to be drawn, both as to what occurs in this type of boiler and also as to what steel tubing can withstand in the way of temperature. Even this comprehensive data is not quite complete, but as the question of comparative transmission rates is concerned with ranges of heat flow, rather than with precise figures, no material error can be involved in the use of certain assumptions—which from the contiguous data must obviously very closely approach the truth—in order to develop an analysis from which much may be learnt. The basis figures of the trials as published are given, as far as is necessary, in Table A (see page 50). Everything which is required is available, with the exception of the furnace temperatures (which are always difficult to measure accurately), the quantity of air supplied and the lower calorific value on the analysis of the fuel, which would admit, by a process of deduction, of the accurate subdivision of the boiler losses into chimney and radiation losses respectively. But as the evaporation, efficiency and total heat supplied are all given, all that it is necessary to do is to assume an excess air factor and from it all calculations regarding the transmission rates can be made, while any inaccuracy that might be involved in the process is entirely submerged by the extent of the results obtained. The standard Babcock & Wilcox marine boiler has tubes 8 ft. long between the headers and $1\frac{13}{16}$ in. external diam., the fire rows being 4 in. in diam. On the opposite page is shown the design of boiler reproduced from the firm's catalogue, the position at which the various temperatures indicated in Table A were taken, being clearly marked. Two features of the design, which at once attract attention, are the relatively very large furnace volume and the large space in which the superheater is housed.

### Analysis of Trials.

The deduced transmissions are arrived at as follows:—With crude oil and good combustion, the excess air factor lies between 1·25 and 1·4 times the quantity of air required for complete combustion, and as about 14·3 lbs. of air are necessary for this, if these limits be taken and the air supply assumed as being directly proportional to the quantity of oxygen as given in the chimney gas analysis, the values of the pounds of air per pound of oil as given in line one of Table B are obtained. Almost identical figures follow by working from the percentage of $CO_2$. From this assumption all the remaining figures in Table B are derived. The table itself is self-explanatory, but attention may be called to one or two points. The calorific value of the fuel as fired divided by the air supply, gives the British Thermal Units per lb. of gas, and the British Thermal Units absorbed or lost, follow from the efficiency and (100 — efficiency) as given in Table A. The latter figure, as the higher calorific value only of the fuel is given, must embrace the loss due to the latent heat of evaporation of the products of the combustion of the hydrogen, and which pass away as superheated steam in the chimney gases. The net chimney loss is directly calculable, and by adding an arbitrary figure for loss due to radiation, the balance between the sum of these and the British Thermal Units lost (line 4) must represent the loss in the latent heat. Obviously, the assumed radiation must be high in the case of trial No. 3, at least, as the latent heat figure with oil seldom falls below 60. The total radiation loss is considered to be divided equally between the furnace zone and the boiler casing, and in estimating the transmission rate per stage, the casing loss is distributed pro rata. By an obvious process of elimination, it is possible to arrive at the quantity of heat put into the fire rows of tubes, the object of the investigation being to see how the maximum transmission rates compare with the maxima obtained in internal-combustion engine practice.

The wide range of combustion on the six tests may be said to centre round the more normal steaming rate under which trial No. 3 seems to have been run. Trials 5 and 6 represent an extraordinary degree of forcing for a boiler of this type, the rates of combustion per square foot of heating surface only being exceeded by a small amount even in torpedo craft under conditions of heavy forcing, while for trials Nos. 1 and 2 at a very low rate of combustion, both boiler and combustion chamber are then far too large for really good efficiency. At the top rates, even the 10 lbs. of oil per cubic foot of furnace has often been exceeded in Yarrow boilers with good efficiency, though 12 to 13 lbs. is about a satisfactory limit. Less should be burnt if space permits. On the low power trials it will be seen that the final temperature of the gases is even less than that corresponding to the steam pressure before entry into the superheater. A noticeable feature in the temperature records is the high value at point 4 just above the horizontal baffle: this is apparently due to radiation or else to leakage from the furnace. But the real point of interest in the analysis lies in the transmission rates.

### Heat Transmissions at Various Stages.

That the usual method of quoting an average transmission rate is a very poor guide to the real intensities experienced is clearly seen in the second part of Table B. The three lower rows of the boiler in question contain about 13·8 per cent. of the boiler heating surface, or 12·25 per cent. of the total, including superheater, and this absorbs anything from 50 to 75 per cent. of the total heat used, averaging about 60 per cent. in normal working. The transmission rate through this collective surface is fully as high as internal-combustion cylinder liner or piston transmissions, and rises to a figure considerably exceeding any cover transmissions at maximum power. Neither boiler nor cylinder cover are likely to withstand such a rate indefinitely or in continuous working, and in any case the brickwork of the former is likely to give out before the tubes do. These figures alone under easy steaming rates, show that a very considerable majority of the heat put into this type of boiler is transmitted at rates far exceeding those of normal internal-combustion engine practice, as, of course, might be expected, both from the material and the working conditions. From the temperature records it is very clear that the drop across a group of tubes is very rapid at first, and this is corroborated by Mr. Harold Yarrow's figures (*Transactions, Institution Naval Architects*) for a three-drum type of boiler in which, when evaporating 16 lbs. of water per square foot of heating surface, and burning about 1·08 lbs. of oil per square foot per hour, the drop was 460° Fahr. across the first three rows, 430° Fahr. across the next three, and 140° Fahr. each across the next two groups of three each. At a very low rate of evaporation—only 3 lbs. per square foot and an oil rate of less than 0·19 lbs. per square foot, the corresponding drops were 400, 300, 110 and 85. Obviously then, the lowest (4 in.) row must have been exposed to some enormous, though not precisely, calculable, transmission rate. Assuming, however, that the two lowest groups each absorb half the total heat put into that stage between the furnace and point 1, then the 4-in. tubes alone take up 41 per cent. more than the mean of the whole group. But this is not quite the whole story. It is very clear that the lower half of these tubes must take up a very much greater amount than the upper half does, and if this proportion be arbitarily divided as two-thirds and one-third, then, even under easy steaming conditions, the 54 sq. ft. of tube surface immediately exposed to the radiation from the furnace are passing heat at a rate equal to Professor Watkinson's maxima for internal-combustion engine covers, this figure rising to double the amount or over 130,000 B.Th.U. per square foot on the maximum power trial. The lower group of three rows (the one 4 in. and two of $1\frac{13}{16}$ in.) passes heat at a rate of four to five times that of the average of the whole boiler; in

the case of the bottom half of the first row the heat is nearly double that absorbed. The magnitude of these transmission rates will probably create some surprise amongst those used to discussing only average rates. The fact is that very little trouble has ever been taken to ascertain the actual rates of transmission in various parts of a big cylindrical marine boiler, and the published literature on the subject is very scanty. When the vast numbers of papers on this subject which have been read before various institutions is considered—Messrs. Dalby and Thearle, in one read before the Institution of Mechanical Engineers as long ago as 1909, gave a list of over four hundred—it is rather surprising to realise how very little data of complete trial analyses of various types of boiler is actually available.

Trials of an Oil-Fired Babcock & Wilcox Water Tube Boiler at Various Rates of Combustion.

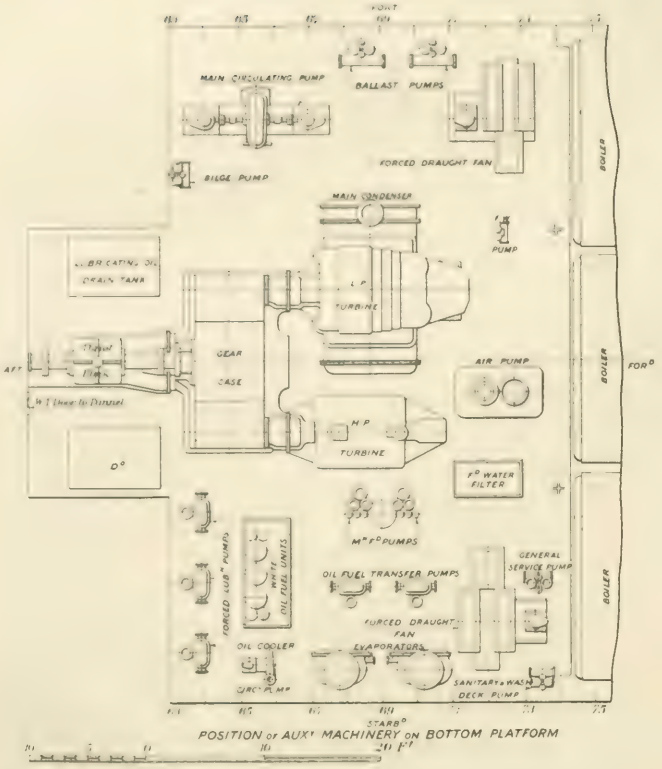
Table A.—*Published Data.*

| No. of Trial: | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Steam pressure, lbs. per sq. in. gauge | 200 | 202 | 199 | 202 | 197 | 201 |
| Steam temperature, deg. Fahr. | 460 | 461 | 488 | 500 | 506 | 529 |
| Superheat, deg. Fahr. | 72 | 73 | 100 | 112 | 120 | 141 |
| Oil burnt per hour, lbs. | 680 | 827 | 1,184 | 1,697 | 2,362 | 2,664 |
| Oil burnt per sq. ft. of heating surface per hour, lbs. | ·308 | ·374 | ·536 | ·768 | 1·069 | 1·205 |
| Oil burnt per cubic ft. of combustion space per hour, lbs. | 2·56 | 3·12 | 4·47 | 6·4 | 8·9 | 10·03 |
| Temperature of feed water, deg. Fahr. | 60 | 61 | 62 | 61·5 | 62·6 | 65 |
| Actual total evaporation, lbs. per hour | 8,275 | 9,900 | 14,100 | 19,500 | 25,966 | 29,550 |
| Actual evaporation, per sq. ft. heating surface per hour | 3·74 | 4·48 | 6·38 | 8·82 | 11·75 | 13·37 |
| Actual evaporation per lb. of oil per hour, lbs. | 12·17 | 11·97 | 11·91 | 11·49 | 11·0 | 11·092 |
| Equivalent evaporation per hour from and at 212 deg. Fahr. per sq. ft. of boiler heating surface— | | | | | | |
| Excluding superheater effect, lbs. | 4·54 | 5·43 | 7·72 | 10·68 | 14·21 | 16·15 |
| Including superheater effect, lbs. | 4·715 | 5·63 | 8·11 | 11·29 | 15·06 | 17·27 |
| Per lb. of oil, lbs. | 15·33 | 15·06 | 15·15 | 14·71 | 14·1 | 14·33 |
| Temperature of gases in deg. Fahr. at positions indicated— | | | | | | |
| 1 | 1,258 | 1,247 | 1,481 | 1,547 | 1,857 | 1,754 |
| 2 | 633 | 676 | 811 | 979 | 1,040 | 1,122 |
| 3 | 450 | 466 | 574 | 660 | 730 | 790 |
| 4 | 510 | 584 | 696 | 831 | 900 | 937 |
| 5 | 338 | 367 | 451 | 523 | 586 | 604 |
| Calorific value of fuel as fired | 18,921 | 18,868 | 18,921 | 18,948 | 18,868 | 18,868 |
| Transmission of heat per sq. ft. of heating surface of— | | | | | | |
| Boiler per hour, B.Th.U. | 4,388 | 5,245 | 7,428 | 10,323 | 13,734 | 15,604 |
| Superheater per hour, B.Th.U. | 1,290 | 1,580 | 2,950 | 4,563 | 6,445 | 8,427 |
| Per cent. of heat absorbed by steam in— | | | | | | |
| Boiler | 75·38 | 74·28 | 73·64 | 71·00 | 68·15 | 68·6 |
| Superheater | 2·83 | 2·86 | 3·72 | 3·98 | 4·08 | 4·76 |
| Efficiency of installation | 78·21 | 77·14 | 77·36 | 74·98 | 72·23 | 73·36 |
| Analysis of Chimney Gases, $CO_2$ per cent. | 12·33 | 12·0 | 11·5 | 12·45 | 12·62 | 12·8 |
| Coal per hour | 4·45 | 5·0 | 5·95 | 4·76 | 4·31 | 4·12 |

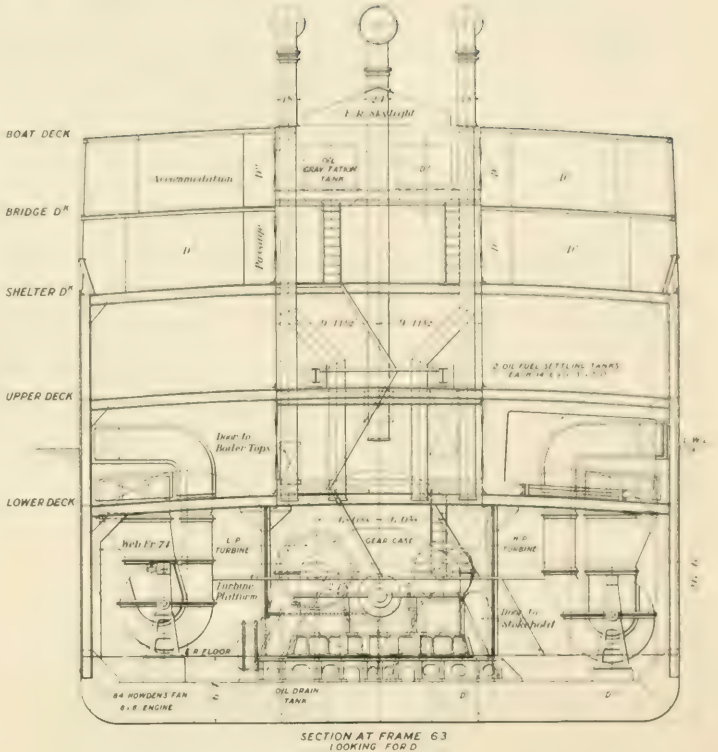
Shipping Company Magazines.—The practice of many shipping firms publishing their own magazines is a commendable one and one moreover which seems to be on the increase. We have recently received a copy of the *Cunard Magazine* now in its tenth volume and also of the *Elder Dempster Magazine*, still in the first volume. Each paper is very well produced and the contributions and articles might be described as delightfully breezy. Amongst the most interesting features of the Christmas number of the *Cunard Magazine* are some of Mr. Kenneth D. Shoesmith's characteristically bold and original sketches. The *Elder Dempster Magazine* contains, besides other features, some correspondingly clever cartoons of company officials, by Fred. May.

TABLE B.—*Deduced Data.*

| No. of Trial : | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Lbs. of air per lb. of oil (taken as) | 18·4 | 19·4 | 20·0 | 18·75 | 18·2 | 18·0 |
| B.Th.U. per lb. of gas supplied .... | 1,030 | 973 | 946 | 1,010 | 1,036 | 1,052 |
| B.Th.U. per lb. put into steam .... | 805 | 750 | 730 | 757 | 748 | 770 |
| B.Th.U. per lb. lost | 225 | 223 | 216 | 253 | 288 | 282 |
| B.Th.U. per lb. passed through boiler from (1) to (5) = amount put into steam + loss in radiation from (1) to (5). | 261 | 277 | 319 | 342 | 400 | 365 |
| Assumed total loss in radiation— Per cent. .... | 10·0 | 9·0 | 8·0 | 8·0 | 8·0 | 7·5 |
| In B.Th.U. per lb. .... .... .... .... .... .... | 103 | 87 | 75 | 80 | 82 | 80 |
| B.Th.U. per lb. lost in radiation from (1) to (5), taken as half of total radiation loss. | 52 | 44 | 38 | 40 | 41 | 40 |
| ∴ B.Th.U. per lb. put into steam from (1) to (5), equals | 209 | 233 | 281 | 302 | 359 | 325 |
| B.Th.U. per lb. lost in chimney gases (= $T_5 - 60°$) × specific heat. | 67 | 74 | 94 | 111 | 126 | 130 |
| B.Th.U. per lb. representing latent heat of evaporation of $H_2O$ carried away in chimney gases. | 55 | 62 | 47 | 62 | 82 | 73 |
| Total B.Th.U. per lb. used and lost between (1) and atmosphere | 383 | 413 | 460 | 515 | 608 | 568 |
| Balance to complete total heat supplied per lb. of gas .... ... | 647 | 560 | 486 | 495 | 428 | 484 |
| Less radiation loss in furnace zone (= one-half total) .... | 52 | 44 | 38 | 40 | 41 | 40 |
| Leaving B.Th.U. put into heating surface between furnace and (1). | 595 | 516 | 448 | 455 | 387 | 444 |
| And which equal in per cent. of heat used .... .... ... | 74·0 | 68·8 | 61·5 | 60·2 | 51·9 | 57·7 |
| And which equal in per cent. of heat supplied .... | 57·8 | 53·1 | 47·4 | 45·0 | 37·3 | 42·2 |
| | B.Th.U. transmitted per hour per square foot of heating surface. | | | | | |
| Total B.Th.U. per hour put into three lower rows of tubes | 7,450,000 | 8,280,000 | 10,600,000 | 14,460,000 | 16,650,000 | 21,300,000 |
| Mean rate through 305 sq. ft. in— Two rows of $1\frac{13}{16}$-in. tubes | 24,430 | 27,200 | 34,800 | 47,500 | 54,700 | 70,000 |
| One row of 4-in. tubes .... | | | | | | |
| Transmission, assuming one-half of total is absorbed in $1\frac{13}{16}$-in. tubes and one-half in 4-in. tubes— 197 sq. ft. in $1\frac{13}{16}$-in. .... .... .... .... .... .... | 18,900 | 21,000 | 26,900 | 36,700 | 42,200 | 54,100 |
| 108 sq. ft. in 4 in. .... .... .... .... .... .... | 34,500 | 38,300 | 49,000 | 67,000 | 77,000 | 98,750 |
| Transmission through the 4-in. tube only, assuming $\frac{1}{3}$ through top half, and $\frac{2}{3}$ through bottom half, in lieu of mean above— Top half | 23,000 | 25,500 | 32,600 | 44,600 | 51,350 | 65,800 |
| Bottom half | 46,000 | 51,000 | 65,200 | 89,200 | 102,700 | 131,600 |
| Transmission per stage, corrected for variation of specific heat, and allowing for half of total radiation loss distributed throughout this zone— $T_1 - T_2 = 765$ sq. ft. .... .... .... .... .... ... | 2,280 | 2,790 | 5,020 | 5,910 | 11,600 | 9,900 |
| $T_2 - T_3 = 282$ sq. ft. .... .... .... .... .... .... | 1,290 | 1,580 | 2,950 | 4,563 | 6,445 | 8,427 |
| $T_3 - T_4 = 545$ sq. ft. .... .... .... .... .... ... | 205 | 735 | 1,175 | 2,450 | 3,320 | 3,170 |
| $T_4 - T_5$ 595 sq. ft. | 610 | 1,265 | 2,190 | 4,020 | 5,500 | 6,445 |
| Ratio of $\frac{\text{given superheater transmission, Table A}}{\text{Heat in gases } (T_1 - T_5) \text{ Cp.}}$ | 64·7 | 53·5 | 59·6 | 53·0 | 54·1 | 62·0 |
| Ratio of mean rate through three lower rows to mean rate of whole boiler (Table A). | 5·58 | 5·2 | 4·69 | 4·6 | 3·98 | 4·48 |
| Ratio of maximum rate through bottom half of 4-in. tube and to mean rate of whole boiler. | 10·5 | 9·75 | 8·8 | 8·63 | 7·48 | 8·44 |
| Increase in gas heat in B.Th.U. per lb. at (4), due to heating through baffle plate. | 28 | 41 | 45 | 59 | 72 | 60 |
| Estimated furnace temperature, deg. Fahr., to give B.Th.U. per lb. between furnace and (1). Cp. = 0·28. | 3,680 | 3,470 | 3,380 | 3,610 | 3,700 | 3,760 |




Plan Showing General Arrangement of Engine Room.




SECTION AT FRAME 63 LOOKING FOR'D

Section through Engine Room at Frame 63.

# MODERN MACHINERY SPACES—I.

**The Furness, Withy Cargo Liner "London Mariner." Built by the Furness Shipbuilding Company Limited, Haverton Hill-on-Tees, and Engined by Richardsons, Westgarth & Co. Limited, Middlesbrough.**

It will be remembered that, in our last volume, we dealt in detail with the machinery spaces of some vessels which went on service during the year. Considerable interest has been taken in these descriptions, and we propose therefore in some ensuing instalments to take in series various types of modern ships and to discuss in detail the mechanical side of their equipment.

The ship we have selected for the first of this series is the single-screw steamer *London Mariner* (ex *Feliciana*), owned by the Gulf Line Limited, of which Furness, Withy & Co. Limited are managers; the vessel operates at present on their Philadelphia-London route, and has dimensions and particulars as shown in the subjoined tables. She is a cargo steamer of the shelter deck type, with raised forecastle, carrying 9,000 tons dw. at 14½ knots, and was built by the Furness Shipbuilding Company Limited, Haverton Hill-on-Tees, on their special principle of fabrication. The ship is also interesting in that the Duct Keel is fitted forward of the stoke-hold; details of this were given in *The Marine Engineer and Naval Architect* for December last. Further particulars of the vessel are as follows:—

*Hull*—

| | |
|---|---|
| Length, over all | 471 ft. 6 in. |
| Length, between perpendiculars | 450 ft. |
| Breadth, extreme | 58 ft. |
| Draft, loaded | 30 ft. 2 in. |

*Tonnage*—

| | |
|---|---|
| Gross registered tonnage | 7,930 |
| Net registered tonnage | 4,947 |
| Deadweight capacity | 9,000 tons |

*Boilers*—

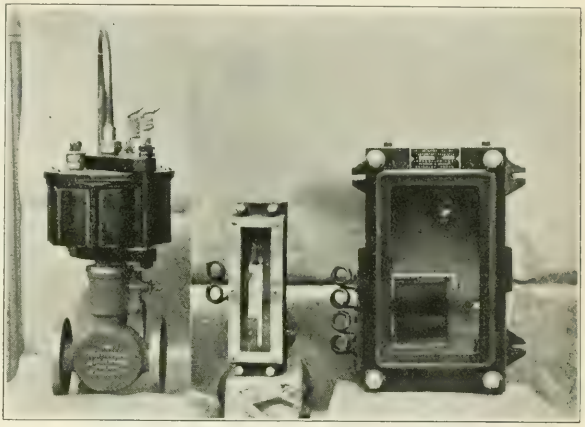
| | |
|---|---|
| Number | Four |
| Type | Scotch |
| Fuel | Oil |
| Draught | Howden Forced |
| Superheat, deg. Fahr. | At Boilers, 120° Fahr.; „ Turbines, 100° Fahr. |
| Working pressure | 190 lbs. per square inch. |

*Engines*—

| | |
|---|---|
| Number and Type | Composite set high-pressure and low-pressure Brown-Curtis turbines, single-reduction gearing. |
| Horse-power | Shaft horse-power, 5,000. |

## Main Propelling Machinery.

The main propelling machinery was constructed by Richardsons, Westgarth & Co. Limited, at their Middlesbrough works. It consists of a high-pressure and a low-pressure Brown-Curtis turbine driving the screw through single-reduction gearing, the high-pressure turbine being on the starboard side of the ship. For running astern, a high-pressure astern turbine is incorporated with the high-pressure ahead turbine and a low-pressure astern with the low-pressure ahead. It is suggested that by dividing the astern unit into two there is an increase in efficiency and in case of a breakdown either of the astern turbines can be separately operated. The installation develops a shaft horse-power of about 5,000, at about 84 to 88 r.p.m. of the main shaft, under normal running conditions. The Aspinall governors fitted at the after end of each turbine are shown on page 55. They are of the patentees' speed and emergency cut-out type, connected up with the gravity oil tanks, this arrangement causing the governor to cut off the steam supply when the oil supply falls below a certain level. Both turbine bearings and thrust block, the latter being of the Michell type, are lubricated by a combination of gravity and forced lubrication systems, as also is the gearing, but the systems are entirely separate. Three pumps are used for lubrication purposes; they are of the Weir merchant simplex type, 9 in. by 8 in. by 18 in., and two are in operation at the same time—one being used as a standby. The control platform for the turbines is shown on p. 59; it is situated on what may be termed the first platform, the revolution counter being situated at the fore end of this, *i.e.*, at the after end of the gear case. The engine room generally is placed in communication with the navigating bridge by means of a Graham navyphone.



**Units of the Baldwin (Electric Control) Isothermal Valve.**

## Boiler Room.

Steam is supplied by four single-ended return tube Scotch boilers fitted with Robinson superheaters, giving a superheat at the turbines of 100° Fahr., the thermo-couples for registering this being of the type supplied by the Cambridge and Paul Instrument Company Limited. The boilers have a length of 12 ft., an internal diameter of 17 ft. 6 in., and a heating surface of 13,400 sq. ft. The working pressure of steam at the boiler is 190 lb. per square inch, and the high-pressure turbine takes it at 180 lb. per square inch. The boilers burn liquid fuel, have the Howden system of forced draught, and the White patent oil burning installation. A view of the starboard side of the boiler room is shown on page 58. The fuel oil is carried in double-bottom tanks as is the usual practice, but, except in No. 4 tank, no heating coils are fitted. The oil is heated by means of a steam heater in the engine room, to which is attached a special electrically operated valve manufactured by James Baldwin & Co. Limited, Keighley, who are patentees of the apparatus. This is termed an isothermal valve, and is of the form shown above. The arrangement, in effect, is one which prevents the oil from getting too hot and, which, when the temperature exceeds 120° Fahr., automatically shuts off the steam supply to the heater, until the temperature falls again. No. 4 tank is used as a warm oil reservoir and from it warm oil can be circulated

to any of the other tanks. The heater is shown on page 56. The Bailey valve consists of three essential parts, a thermometer, a valve and a relay. The control valve is of 1-in. bore, has flanged ends and a working pressure of 100 lb. per square inch. The thermometer is fitted in a damp-proof casing, and the required cut-off temperature can be suitably adjusted by means of a nut and pinion.

### Condensers and Pumps.

The main circulating pumping plant is illustrated on page 59. The installation, which is driven by one of two high-speed enclosed type reciprocating engines, is of the centrifugal type manufactured by Dryesdale & Co. Limited. The main condenser is of the Contraflo type, for which the engine builders are licencees, and an illustration of it will be found on page 59.

This condenser with the sea-water at a temperature of 80° Fahr., is intended to give a vacuum of 27½ in. of mercury. The air pump is of the kinetic reciprocating type, independently steam-driven, working in conjunction with a steam jet. The main condenser is placed directly underneath the low pressure turbine, and the auxiliary condenser, which deals with the exhaust steam from the deck machinery and engine-room auxiliaries, is of the same type. The ballast pumps and their valve chest are shown on page 57. They are, as will be seen, of the vertical type with brass water ends, each of 200 tons capacity, and one of them is used in port, in conjunction with the auxiliary condenser.

The respective valves in the valve chest, shown in pairs commencing from the top, are as follows:

| | |
|---|---|
| (1) Top pair | Ballast Discharge. |
| (2) 2nd pair | Discharge to forward tanks. |
| (3) 3rd pair | Discharge to after tanks. |
| (4) Bottom pair | Discharge to auxiliary condenser. |

While discussing the condensing plant, it is interesting to note the water meter shown on page 58, supplied by the Leeds Water Meter Company Limited. This registers the exact amount of water passing from the condenser to the main feed pumps in any given period, and there is also another similar instrument fitted for the auxiliary condenser. The main feed pumps and their connections are shown on page 59. the pumps were manufactured by Nicholl & Co. Limited, Northallerton, and are of the independent type, 13¼ in. by 10 in. by 26 in., with gunmetal water ends. They are fitted with float tank and control gear. The fan engines, the port side one of which is shown on page 57, are of the enclosed forced lubrication type and each drives a fan 84 in. in diameter.

The engineers of the *London Mariner* are fortunate in having the vessel's spare tail shaft stowed in a readily accessible place, as will be seen from page 58; a position which would, should the necessity arise, allow for getting the new shaft shipped into place in the minimum of time.

### Generating Plant, Refrigerating Plant and Workshop.

The ship's workshop and engine room store, together with the electric lighting units and refrigerating machinery are situated on what might be termed the second platform. The workshop contains the two generating sets, one for use at sea, and the other for port use, the refrigerating machinery, a drilling machine by Loudon Bros., of Glasgow, and a well-equipped power-driven lathe by Scott Bros., Keighley.

### Generating Plant.

The larger unit, which we illustrate on page 59, consists of a 20-kw. shunt-wound machine giving 200 amps. at 100 volts, the manufacturers being Campbell & Isherwood Limited. It is driven by a high-speed enclosed crankshaft engine by Jas. Howden & Co. Limited, running at about 500 r.p.m. The small installation (see page 56) was manufactured entirely by Campbell & Isherwood and consists of the usual high-speed enclosed crankshaft reciprocating engine, which also runs at about 500 r.p.m., and of a 7½-kw. shunt-wound generator giving 75 amps.at 100 volts. The switchboard is manufactured by the ship's builders, but the fuses are by Telford Grier & Mackay Limited, Glasgow.

The refrigerating plant controls the refrigeration of the vegetable room, meat room and provision room, and was supplied by J. & E. Hall Ltd., Dartford.

The engine room is well ventilated, and the general outlay strikes the observer, even from a cursory glance, as good. Another interesting point about the vessel is the ventilation of her holds, which is aided by means of electric-suction fans, supplied by Gibbs Limited, of Liverpool, fitted in the ventilator coamings; this is an especially useful feature for many types of cargo. There are six engineers, who are all accommodated amidships in well-fitted cabins.

## MANUAL PROPULSION.

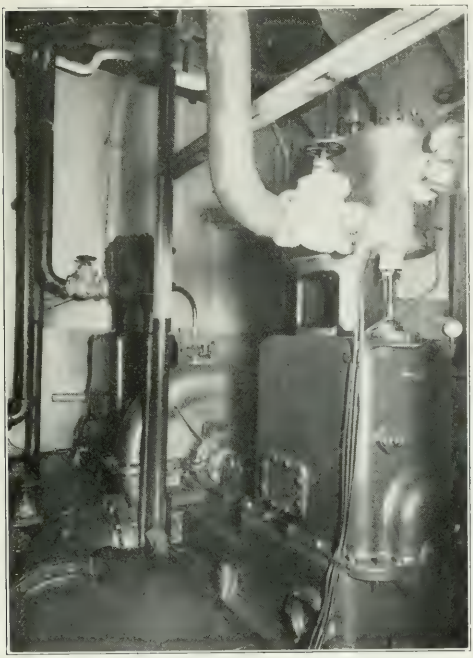
**The Design of Racing Eights and the Theory of Rowing: Some Recent Work on the Subject.**

It may be of interest to marine engineers, and to all those who are directly concerned with the science and practice of mechanical propulsion in ships, to note that the most primitive form of all marine propulsion—viz., rowing—is by no means neglected from a scientific and academic viewpoint. True, the oar propulsion of any vessel is now confined mainly to the realms of sport, but the principles involved in the design of racing boats are of more than passing interest by reason of the fine points of naval architecture they involve. This also applies to the theory of rowing, which brings in its train some eminently practical mechanical principles. Mr. W. B. Coventry* has recently written a very interesting little book upon subject [illegible] "to suggest a means of increasing the speed of the racing eight," which contains a great deal of interesting information with regard to wetted surface, &c. Mr. F. H. Alexander, M.Sc., has contributed an essay, equally important, to the Proceedings of the University of Durham Philosophical Society, dealing with the theory of rowing.

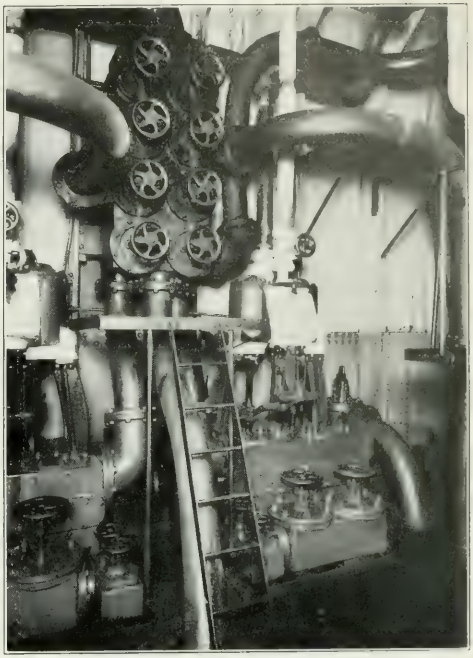
Within the limits set by the author, this brief essay gives a very complete account of the mechanics of the movements of men and of boat, as illustrated by the case of a "racing eight." He shows how the thrust of the oars is obtained, by means of which the boat is propelled, and explains how the moving to and fro of the bodies of the rowers reacts upon the speed of the boat. He brings out the interesting fact that the boat moves faster during the time the oars are in the air than when they are in the water, and shows how a race may be won by a crew whose oars are on the "feather" while those of their opponents are giving a "stroke," both boats being level a short distance from the finishing line. Graphic methods are employed to illustrate the speeds of the movements of men and of boat. The forces exerted by the rowers are worked out, and are found to come into close agreement with such measurements as have been made in actual cases.

* "The Racing Eight, and Notes on its Design and Propulsion," by W. B. Coventry. W. Heffer & Sons Ltd., Cambridge.

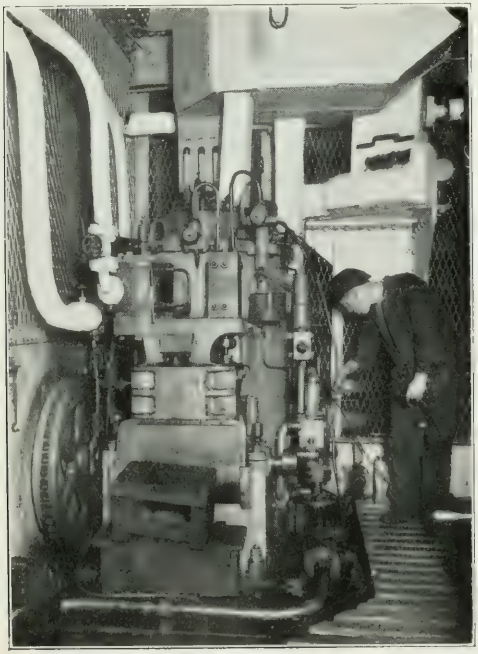
OF THE "LONDON MARINER."



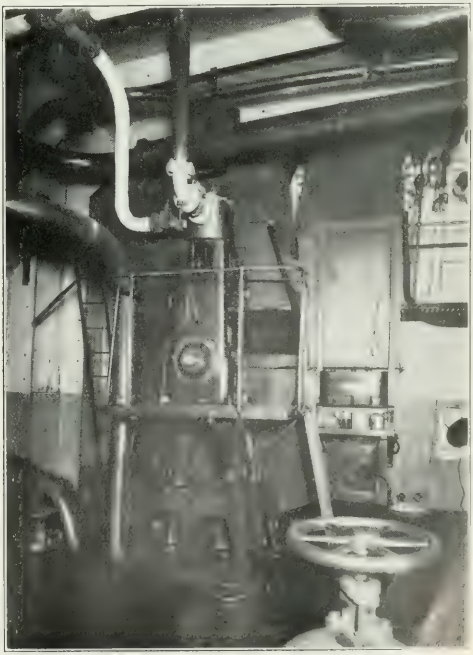
Main Circulating Pump. View shows the Two Engines.



Ballast Pumps and their Connections on Port Side of Engine Room.



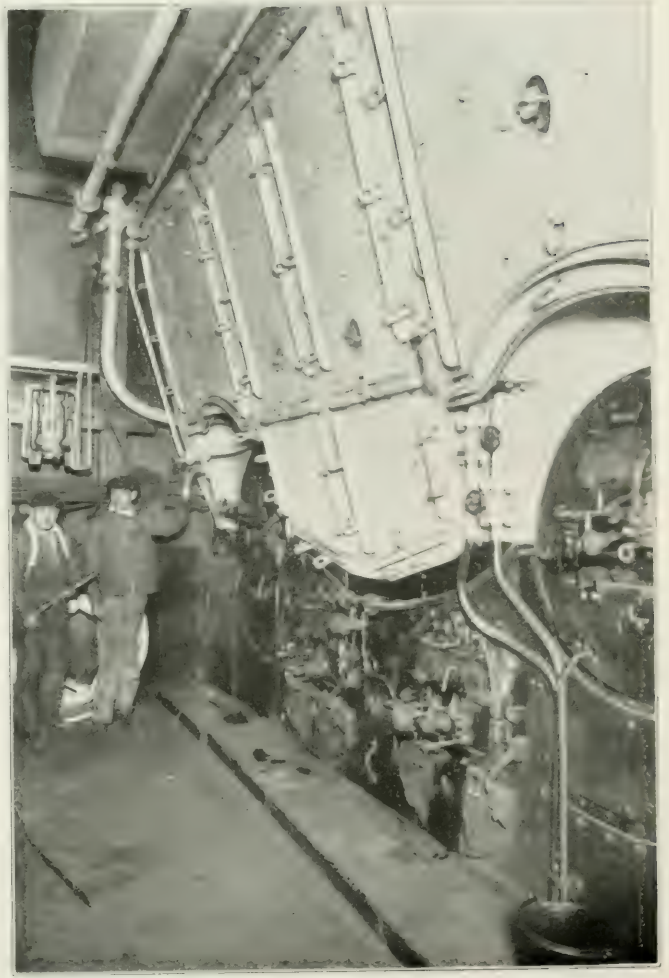
Refrigerating Machinery for Ship's Provisions.



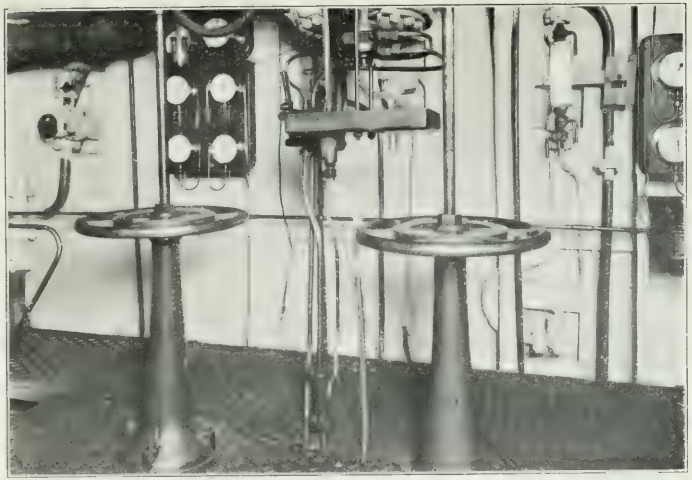
Fan Engine, Port Side, for Forced Draught Fan.

View showing the Water Meter used to measure the amount of water passing from Condenser to Main Feed.

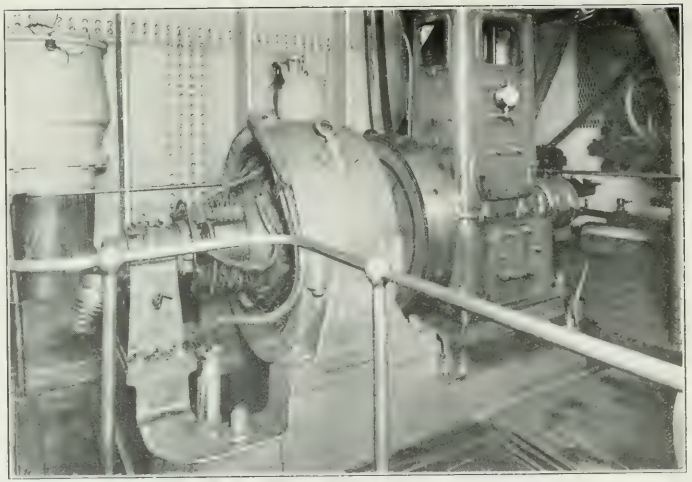
View of After End of Shaft Tunnel, showing Accessibility of Spare Tail Shaft.



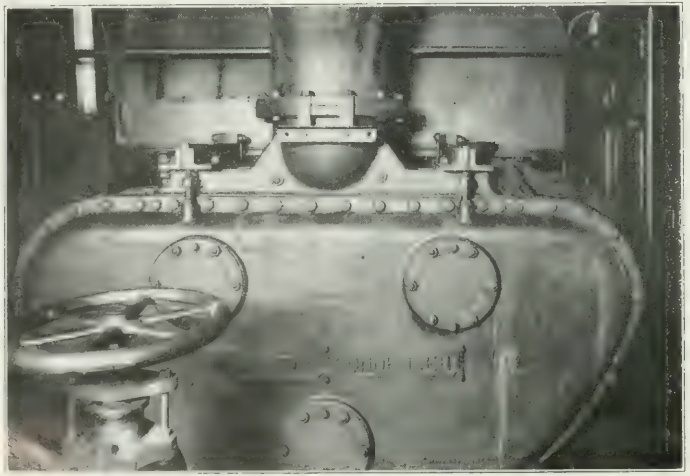
Boiler Room, Starboard Side, showing Oil-Burning Installation, and Howden Forced-Draught System.



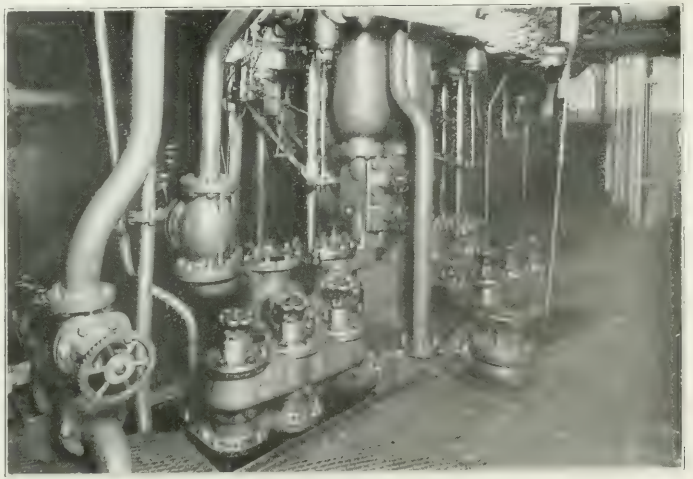
Turbine Manœuvring Platform, showing Controls and Gauges.



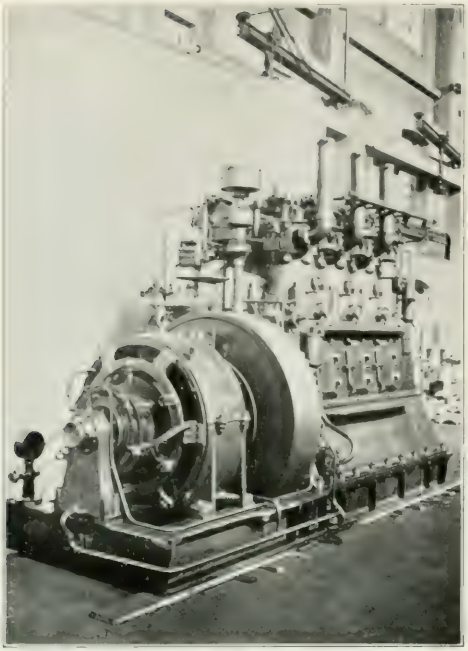
Large Generating Set, 20-kw. Output.



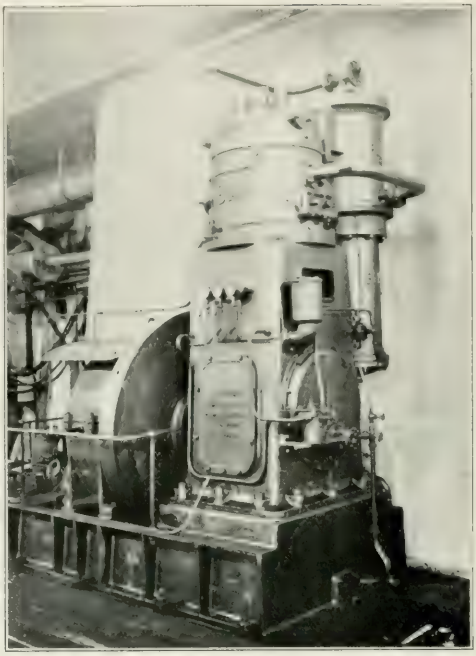
Main Condenser, Contraflo-Type.



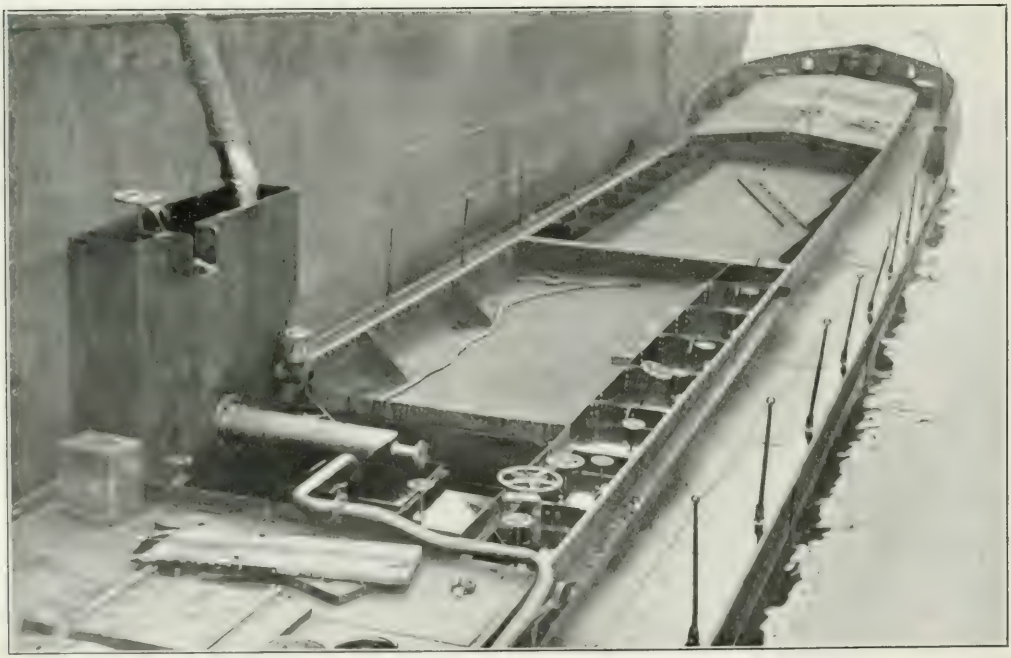
Main Feed Pumps and Connections.



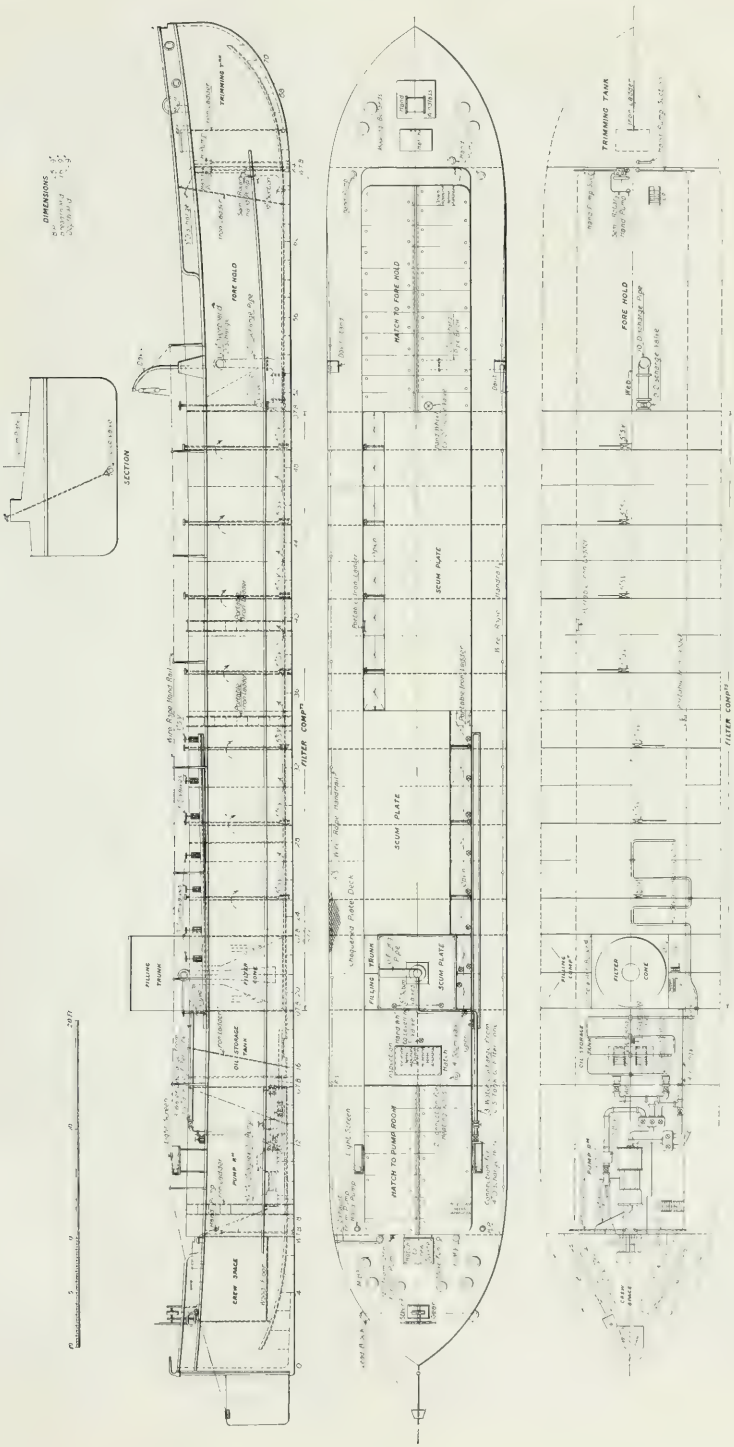
Three-Cylinder 150 B.H.P. Auxiliary Engine, by Burmeister & Wain, Ltd.



Manœuvring Compressor of Multi-Stage Type, by Burmeister & Wain, Ltd. (See page 43.)

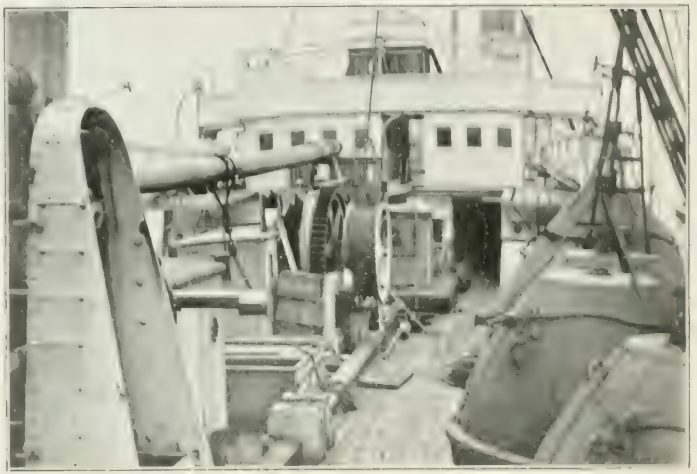


Deck View of Oil Separator Barge, showing Receiving and Cone Separator Compartments. (See page 74.)




Barge for Separating Oil from Water Ballast. Sectional Elevation and Plan Views. Designed and built by Smith's Dock Company, North Shields. (*See page 74.*)

The Cable Ship "Faraday" (1874). Exterior view of the Ship.



The "Faraday," Deck view looking Aft from F'c'sle, showing Cable-Hauling Gear and Buoys

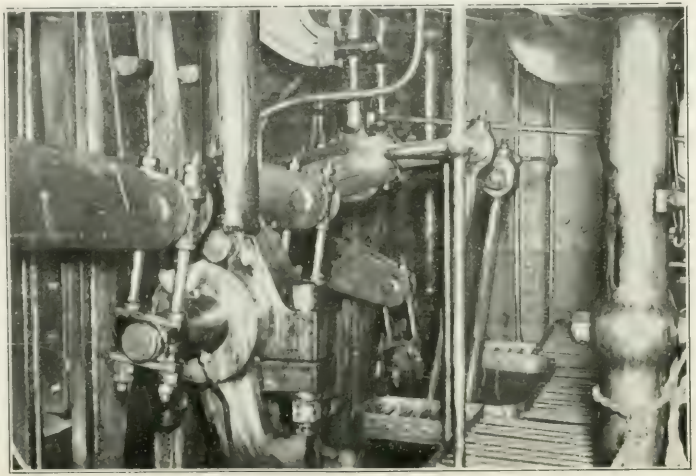
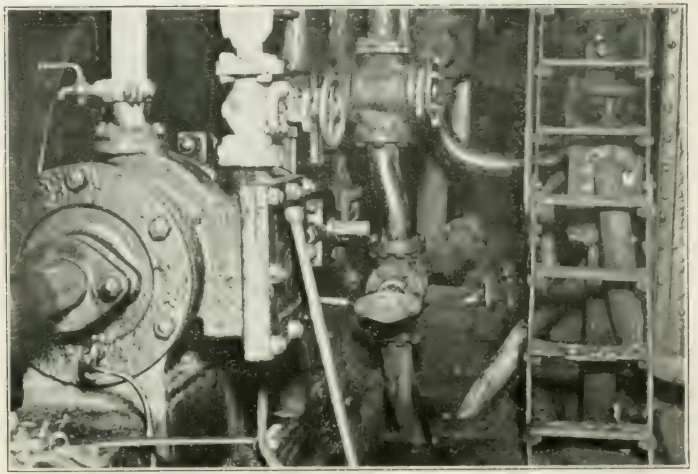


Photo by

View of Starboard Compound Engine, showing Reverse Gear and end of Drive to Pumps.



Topical.

View showing Starboard Ballast and Bilge Pump in Boiler-Room Passage.

# A REVIEW OF DIFFERENT TYPES OF MARINE INTERNAL-COMBUSTION ENGINES*—PART I.

**Data put before the North-East Coast Institution—Scope of Inquiry—Armstrong-Sulzer—Camellaird-Fullagar—Doxford Opposed Piston.**

The following important papers were contributed by builders of representative types of marine internal-combustion engines, who were required by the North-East Coast Institution to fulfil the conditions of the undermentioned specification :—

## Specification.

Vessel to be in accordance with the accompanying diagram.†

NOTE.—The space available for the machinery is shown by figured dimensions and is more than sufficient to obtain the

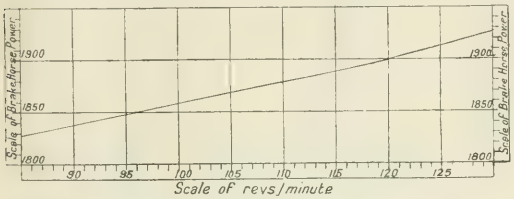



**Fig. 1.—Curve shows estimated B.H.P. for a Speed of 10¾ knots on Trial, with best Propeller available for Different Revolutions.**

32 per cent. deduction from gross tonnage. This deduction would be obtained if the length of the engine room were reduced to 40 ft.

A further diagram (Fig. 1) is supplied showing the estimated least brake horse-power required at different revolutions of the propeller in order to develop the thrust horse-power required to maintain 10¾ knots on trial. The estimate is based on R. E. Froude's published experiment data for four-bladed bronze propellers. At each number of revolutions the brake horse-power shown is that which would be required to drive a propeller of the given type having a diameter and pitch ratio giving the best efficiency, subject to the condition that the diameter must not exceed 14 ft. 9 in., the maximum allowable by the size of the screw aperture. While the actual brake horse-powers shown by this curve are, of course, open to dispute, it is thought that the proportionate increase of power required to drive the ship with faster-running engines will be generally admitted.

*Boilers.*—The boiler is intended to generate sufficient steam for the following purposes, which may require steam simultaneously :—

(*a*) Steam windlass, 9½ in. by 12 in.
(*b*) 9 steam winches, 7 in. by 10 in.
(*c*) 1 Steam winch, 7 in. by 12 in.
(*d*) 1 8-kw. electric generating set.
(*e*) Steam heating of accommodation.

At sea only (*d*) and (*e*) will be required, and the surplus boiler power can be used for steam steering (which would require an 8½-in. by 8½-in. engine), bilge pumps, or any engine auxiliaries which the main engine designer desires to be driven by steam.

The engine designer should install a boiler of sufficient size to provide for the whole of the auxiliaries mentioned above, together with any others which he intends to be steam driven.

On the other hand, the main engine designer may, if he prefers, fit no boiler at all, subject to the provision of equivalent power in electric generators driven by internal-combustion engines for the auxiliary purposes mentioned above, although it may be necessary for the vessel to be fitted with one smallish boiler if only for accommodation heating purposes.

*Information in Papers.*—Papers to give the following information :—

1. Total brake horse-power of the propelling engines, stating whether it can be maintained continuously, and, if not, for what length of time.
2. Overload obtainable in brake horse-power above trial conditions.
3. Mechanical efficiency of the engine, stating the basis upon which the figure has been arrived at.
4. Consumption of fuel per brake horse-power when the ship is steaming at the designed speed :—
   (*a*) For main engines only, and (*b*) For all purposes.
5. The brand of fuel assumed and its calorific value. What fuels would be recommended for continuous running, and whether the engines would run satisfactorily on the heavier boiler fuel oils for a continuous period.
6. The total weight of the main propelling engines and auxiliaries in engine room.
7. Cost per ton-mile.

Authors to be prepared to guarantee their horse-power figures, if required to do so.

Length of Papers : Not over 1,000 words.

Diagrams : Not more than three, *i.e.*, profile, plan and mid-ship section.

The following questions were asked by one of the contributors of Papers to the Review, and the answers indicated were supplied by the Institution :—

1.—*Q.* What fully-laden sea speed is required ?
*A.* It is not desired to specify a sea speed for the vessel because so many indefinite conditions unconnected with the performance of the engines are involved, in the relation between trial speed and sea speed. It is considered that the contributor would best define the practical efficiency of the engine which he describes by giving the following information :—
(*a*) The brake horse-power which the contributor is providing in the engine to enable a speed of 10¾ knots to be maintained on a four-hours' trial.
(*v*) What brake horse-power (or percentage of the trial brake horse-power) can be maintained by the proposed engines on a 3,000 mile run under ordinary sea conditions.

2.—*Q.* Is it necessary that the steam power of the boiler should be such that the windlass and winches are to be operated simultaneously ? (Presumably, when the winches are working the steam windlass will not be in use.)
*A.* It is considered that for the purpose of securing uniformity of conditions under which the contributions are submitted, the boiler should be of sufficient capacity to supply the cargo winches and the windlass simultaneously if both are steam driven as laid down by the specification issued on June 10, 1922. It is, of course

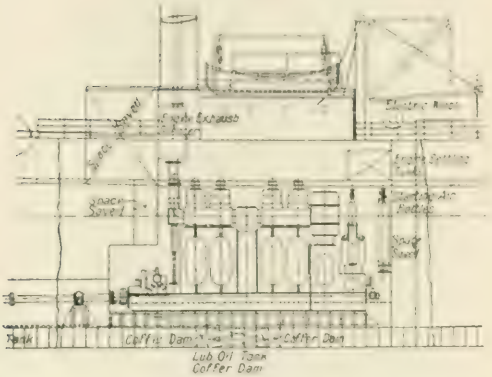
* A collection of papers read in Newcastle before the North-East Coast Institution of Engineers and Shipbuilders, on January 12, 1923.

† This diagram is reproduced by the majority of the contributors to the Review.

open to the contributor to provide for one or both of these services to be electrically driven if the steam boiler power saved in this way is replaced by the equivalent in electric generators.

*Q.* Maximum space available for machinery. We presume this means the minimum space.

*A.* No limit is set on the length of machinery space which may be taken by the engine designer but it is requested that contributions will show



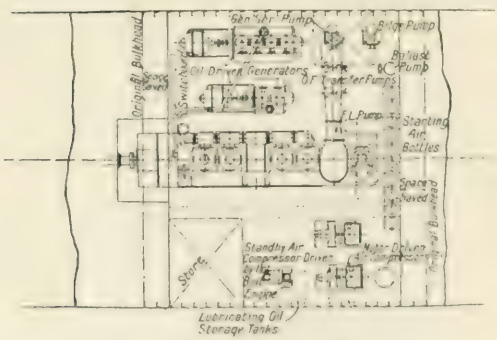




**Fig. 2.—Proposal B. Armstrong-Sulzer Engines and Electric Driven Auxiliaries.**

the difference between the length of machinery space taken by them and that shown on the standard drawing issued with the latter inviting the contribution, and that they will state the volume in cubic feet thus added to or subtracted from the available cargo space.

*Q.* Total cost per ton-mile. We take it this will be the cost only of fuel and lubricating oil for the machinery.

*A.* If the contributor is prepared to give an estimate of the total average cost per ton-mile of carrying cargo in the ship, specifying the assumptions on which the estimate is based, members of the Institution will, no doubt, be pleased to consider and discuss the figures. Inasmuch, however, as the papers are expected to show the effect of [illegible] on the cost of cargo carrying, it is not desired to lay down the requirement that any estimate beyond the cost per ton-mile of fuel and lubricating oil and number of engine-room staff should be given. For purposes of comparison the speed of transport on which this estimate is based should be that obtained *under trial conditions* when developing the brake horse-power which can be developed by the engines continuously on a voyage of 3,000 miles.

## No. 1.—The Armstrong-Sulzer Diesel Engine.

By Sir W. G. Armstrong, Whitworth & Co. Ltd.

*Proposal (A) Steam Driven Auxiliaries* (Page 65).
*Proposal (B) Electrical Auxiliaries* Fig. 2

### Proposal (A). Engine with Steam Auxiliaries.

In this ship the largest standard size of engine of the Armstrong-Sulzer two-stroke cycle type is one having four cylinders 650 mm. (26·77 in.) bore, 1,200 mm. (47·24 in.) stroke which will develop 2,000 b.h.p. continuously at sea at 100 revolutions, and for 6 hours' trial would develop an overload of 10 per cent., viz., 2,200 b.h.p., which could be increased to 18 per cent. for short periods, but with the latter overload the high resulting pressures are not to be recommended. To meet the specified requirements the engine would be run at 92 revolutions, at which speed it will develop 1,840 b.h.p. continuously at sea.

The mechanical efficiency of the engine, making the necessary allowance for the power absorbed in friction of the engine, together with the power required for driving the separate turbo-blower, air compressor, cooling water and lubricating-oil pumps, is approximately 73 to 75 per cent.

The consumption of fuel is 0·386 lb. per brake horse-power for the main engine only, and for all purposes under sea-going conditions approximately 0·512 lb. per brake horse-power, which includes the fuel for the donkey-boiler. The consumption of fuel for the main engines is on the assumption that the fuel oil has a net calorific value of 18,000 B.Th.U.'s.

The engine will run satisfactorily on the heavier boiler fuel oils for a continuous period if the content of sulphur is not more than 3 per cent. and the content of asphaltum not more than 15 per cent. With such fuel oils the engine will, of course, require more frequent overhauls than if run on any of the usual Diesel oils.

#### Auxiliaries.

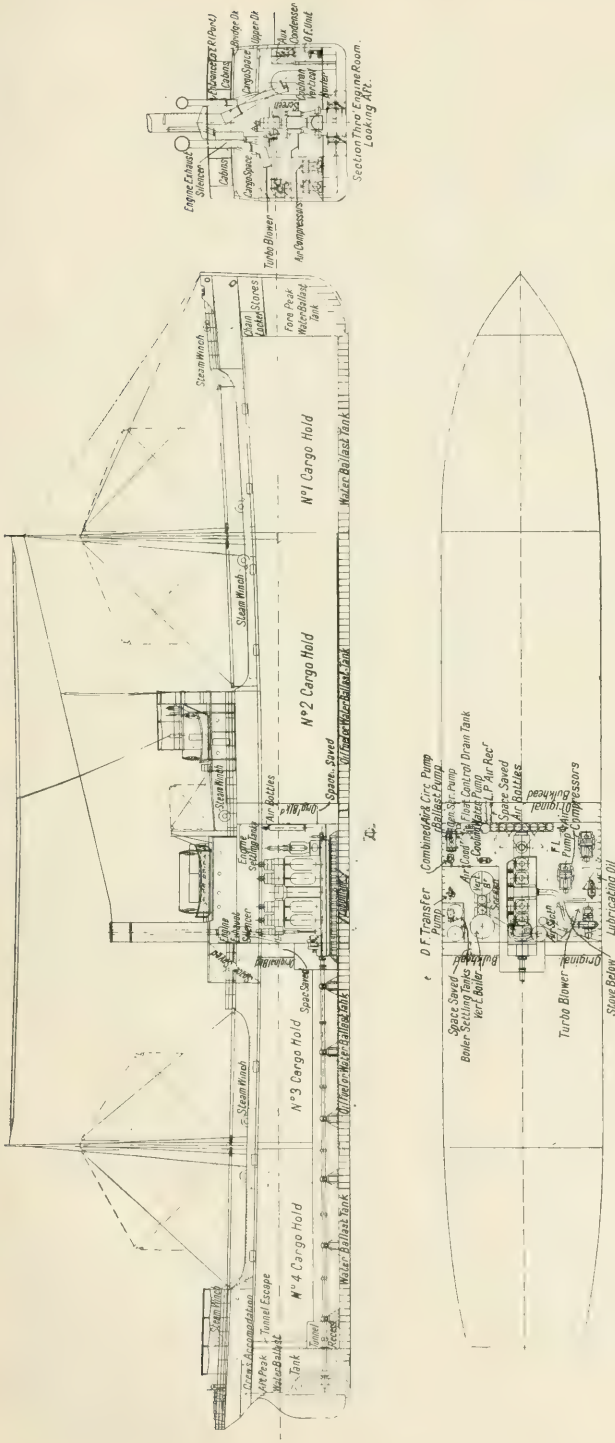
The air compressor, bilge and lubricating-oil pumps are driven off the main engine. The scavenge air and cooling-water pumps are driven by steam turbines which exhaust into the winch condenser. The auxiliary air compressors and the remaining auxiliaries are of the ordinary steam reciprocating type.

There are two oil-fired Cochran boilers, as shown, one of which will be used at sea and two in port. The arrangement shows the two Cochran donkey-boilers in the engine-room, as it is thought advisable to have the installation under the supervision of the engineer on watch, and the natural draught with this arrangement is also improved.

The overall length of the engine should be noted. This is obtained by the introduction of an independent steam-turbine-driven scavenge blower, which supplies scavenge air to the cylinders.

#### Characteristics of the Engine.

When comparing the merits or demerits of an oil engine, the factor that predominates over all others is reliability. Simplicity of design ensures reliability, and the details in this engine, are remarkably simple, as for instance, the cylinder cover and the reversing gear, &c. The liner is, perhaps, a little more complicated than the four-stroke type, but it must be remembered that the temperature of the exhaust gases is only 160° Fahr. the bars between the ports are efficiently cooled and hundreds of liners of this type have been subjected to working conditions over many years without trouble.




**Proposal A. Cargo Vessels, Armstrong-Sulzer Engine and Steam-Driven Auxiliaries.**

The valve-controlled super-charge port in the Armstrong-Sulzer engine is one of its special features. The introduction of a blast of pure air into the cylinder as in this engine is well worth the few additional details.

The piston head is cooled by water through telescopic pipes arranged in such a manner that the gland is never subjected to water pressure. In the Armstrong-Sulzer cylinder cover, there is only one housing carrying the fuel spray injection valve and the starting-air valve; hence a very simple design of cylinder cover is obtained. The fuel pump, governor and the rotary scavenge valves are driven off the vertical shaft at the aft end of the crankshaft, each cylinder being supplied with fuel oil from its own plunger in the fuel pump. The fuel pump supply is controlled by hand and by the governor.

The starting and manœuvring engine consists of two air-driven inverted cylinders set at about 60° to each other with a very neat arrangement of interlocking gear. The starting is effected by first putting compressed air on all cylinders, then two on air and two on oil, then all four on oil. During this operation the fuel pump lubricating-oil supply, &c., are all automatically brought into operation in their proper sequence.

The lubricating-oil pump on the engine discharges the oil to the gravity tank which supplies the main bearings and the bottom ends. The cross-head lubrication is supplied by two small pumps at a suitable pressure. The cylinders, air compressors, and the rotary valves are lubricated by small sight feed pumps driven from the camshaft. The air compressor, which is driven off the crankshaft, is of the three-stage stepped-piston type. The valves are of the automatic plate-ring type; the low-pressure and intermediate pressure valves being identical to reduce the amount of spare gear carried.

The capacity of the compressor is sufficient for spraying air injection with a margin when necessary for the charging of the starting-air bottles, the quantity of suction air to the compressor being under hand control.

The total weight of the main propelling machinery, auxiliaries, &c., in proposal (A) is approximately 405 tons. The cost per ton-mile (nautical miles), assuming 6,500 tons of cargo, in proposal (A) is approximately 0·0061 pence. This figure includes fuel oil, lubricating oil, and the salaries of the engine-room personnel.

The amount of cargo space saved in the proposed ship is 14,640 cubic ft. in proposal (A), and 11,020 cubic ft. in proposal (B) which follows.

### Proposal (B). Armstrong-Sulzer, with Electric Auxiliaries.

Proposal (B) shows an Armstrong-Sulzer engine with electric auxiliaries, and in this proposal the scavenge air pump is

arranged on the main engine to avoid the necessity of fitting a high-speed motor-driven scavenge blower, as at present there is some difficulty in obtaining suitable electric motors in this country.

In this arrangement, the bilge, sanitary, piston cooling, cooling water, and lubricating pumps are driven off the main engine. The separate auxiliaries to consist of the following motor-driven pumps:—Ballast, bilge, general service, fuel transfer pump; a suitable air-driven lubricating pump in case of emergency, two Diesel-driven generators, two motor-driven auxiliary compressors and a small stand-by hot-bulb engine are also provided.

The total weight of the main and auxiliary machinery under proposal (B) is approximately 114 tons, and the cost per ton mile, assuming 6,500 tons of cargo, is approximately 0·1054 pence; this figure includes fuel oil, lubricating oil, and the salaries of the engine-room personnel.

In conclusion, mention should be made of the spare gear. The Armstrong-Sulzer four-cylinder engine has only 12 valves in communication with the heat of combustion, and therefore very few spare parts are necessary for the valve gear.

Proposal (B) is put forward simply as a matter of interest to those who wish to compare the all-electric proposition with the steam-auxiliary proposal.

## No. 2.—The Camellaird-Fullagar Marine Oil Engine.

By PALMERS SHIPBUILDING & IRON CO. LIMITED, and CAMMELL LAIRD & CO. LTD.

The type of machinery put forward for the proposed motor cargo ship is representative of that being manufactured by the following firms of shipbuilders and engineers in this country:

Cammell, Laird & Co. Limited, Birkenhead
John Brown & Co. Ltd., Clydebank.
Palmers Shipbuilding & Iron Co. Ltd., Jarrow.
Smith's Dock Co. Ltd., Middlesbrough.
David Rowan & Co. Ltd., Glasgow.
Dunsmuir & Jackson Ltd., Glasgow.

The main features of the engine, which has been developed by Cammell, Laird & Co. Ltd., Birkenhead, are now well known, but a short *résumé* of its characteristics will not be out of place.

### Description of Engine.

The engine is of the opposed-piston type, the cylinder liner being an open-ended tube with exhaust ports at one end and scavenging ports at the other, which are uncovered by the pistons, so that a straight-through scavenge is accomplished. The elimination of the cylinder cover and exhaust valves are useful objects obtained by this feature of the design, and with the large air-port area available, the scavenging pressure for the lower-speed engines is only 1 to 1·5 lb. per sq. in. Owing to the manner in which the upper and lower pistons are cross-connected, the three cranks and connecting rods required by the most familiar type of opposed-piston engine per cylinder are reduced to one of each per cylinder. Other outstanding features are the high degree of balance, which relieves the riveted engine seating of a good deal of vibration, and the balance of the piston loads, which frees the engine framing of all direct stresses. The combination of these features in one engine has resulted in the production of a highly efficient machine which has given fuel consumptions down to 0·39 lb. per brake horse-power per hour, and, with the inclusion of further improvements in later designs, it is anticipated that this figure will be reduced.

The absence of exhaust valves makes the engine very suitable for burning lower grades of fuel than those in common use, and one engine has recently completed a satisfactory run of one week on Mexican boiler fuel oil, having a specific gravity of 0·95. Particulars of this have already been published. In addition, two engines have made runs at sea of about 600 hours each on Borneo fuel oil having a specific gravity of 0·937.

The push-and-pull applied to each crank of the engine comes in useful when slow speeds are desired for manœuvring. Professor Watkinson, of Liverpool University, conducted some tests on a four-cylinder 25 in. stroke engine, and certified it to run steadily without missfiring at 16½ r.p.m., which corresponds to a piston speed of 68·7 ft. per minute—the lowest piston speed, so far as is known, at which an internal-combustion engine has successfully operated continuously. From this performance it will be evident that with longer strokes and six-cylinder engines, lower revolutions can be obtained if desired.

The engine chosen for the present ship, Plate II, is a four-cylinder one, having cylinders of 24 in. diam. by 36 in. piston stroke, running at a speed of 85 r.p.m., or the lowest speed permitted by the chart accompanying the invitation of the Institution. Electrically-driven auxiliaries are assumed, this being the most modern convenient and economical system.

A smaller and higher-speed engine could be put forward, but as the engine room is already down to the minimum allowed by the tonnage laws, there would be no gain in cargo space and the slower speed, more efficient engine makes the most attractive proposal.

At the revolutions selected the brake horse-power required is 1,828, and the mean indicated pressure in the cylinders would be the moderate one of 91 lb. per square inch, or, if referred to brake horse-power, approximately 65 lb. per square inch, and this rating can be guaranteed as a continuous one. The piston speed is only 510 ft. per minute, and the effect of this on overhauling and reliability need not be enlarged upon. Opposed-piston engines having brake mean pressures of 80 to 90 lb. have been satisfactorily at work for long periods, so that an overload capacity up to 2,300 b.h.p. at 92 r.p.m., which is approximately the speed according to the propeller law (an overload of 25 per cent.), would be easily available. The apparently low continuous rating adopted is convenient in many ways, as it provides a very large overhead factor that can be drawn upon in cases of emergency.

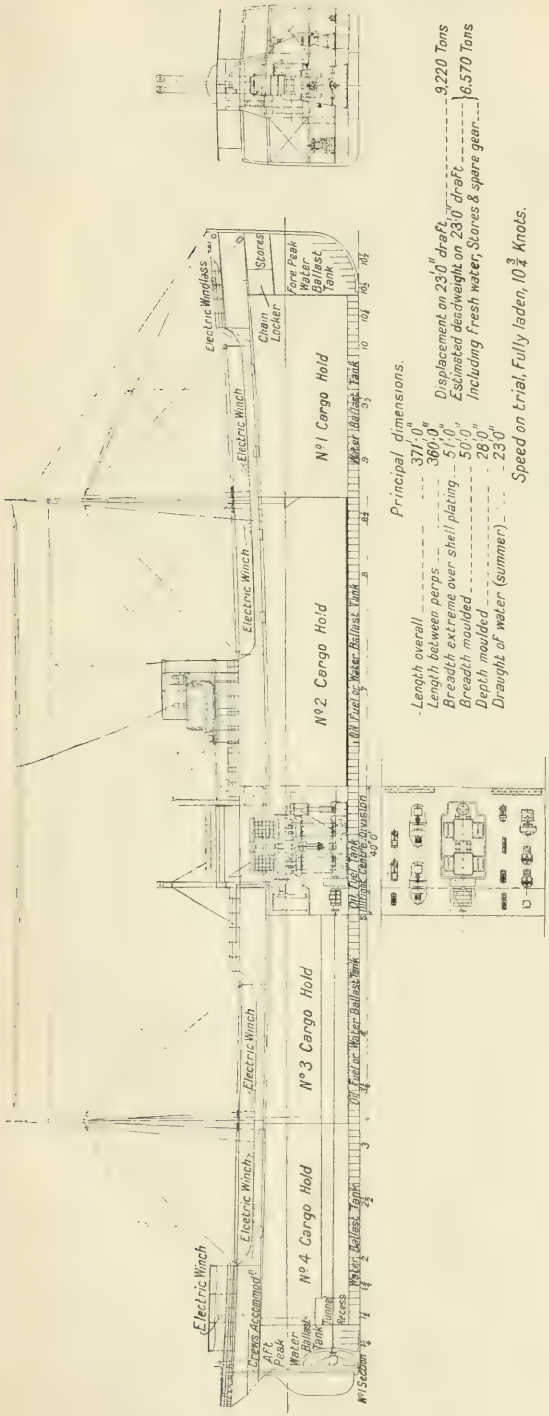
### Auxiliaries.

The main engine drives all its own circulating pumps, compressor, scavenging pumps, &c., the object being to render the operation of the engine independent of all auxiliaries, as stoppage of the auxiliary engine driving the circulating pumps, &c., would necessitate stopping the main engine. It is also the most economical system, as the continuously running pumps are driven by a high-efficiency prime mover and the double electrical losses are avoided. Incidentally there is another important advantage in this arrangement. It is well known that the first start of a Diesel engine is, as a rule, the most difficult, as the engine is cold. With separately-driven circulating pumps, the engine is cooled down as soon as it stops, so that each start is a cold one unless an attendant is told off to manœuvre the pumps.

### Mechanical Efficiency.

The mechanical efficiency of the engine would be about 73 per cent., and is simply represented by the brake horse-power divided by the indicated work developed by the working cylinders only. This figure would be somewhat higher if, as is the case with most marine oil engines, the cooling pumps were driven separately.

When developing the full rated power of 1,828 b.h.p., the main engine only would consume 0·39 lb. per brake horse-power per hour or 7·65 tons per day. With one auxiliary engine running for driving the steering gear, ship's pumps that may be working intermittently, and for lighting and heating, about 50 b.h.p. would be required. This figure is based on actual data from ship's running, and will obviously vary slightly according to climatic conditions. If 0·25 tons per day is allowed for this item the daily fuel consumption will be approximately 7·9 tons.


Principal dimensions.
Length overall ... 371'-0"
Length between perps ... 360'-0"
Breadth extreme over shell plating ... 51'-0"
Breadth moulded ... 50'-0"
Depth moulded ... 28'-0"
Draught of water (summer) ... 23'-0"
Displacement on 23'0" draft ... 9,220 Tons
Estimated deadweight on 23'0" draft ... 6,570 Tons
Including fresh water, Stores & spare gear...
Speed on trial, Fully laden, 10¾ Knots.
Electric Windlass
Stores
Chain Locker
Fore Peak Water Ballast Tank
Electric Winch
No 1 Cargo Hold
Water Ballast Tank
No 2 Cargo Hold
Oil Fuel or Water Ballast Tank
Oil Fuel Tank
Single Cargo Division
No 3 Cargo Hold
Oil Fuel or Water Ballast Tank
No 4 Cargo Hold
Crews Accommod.
Aft Peak Water Ballast Tank
Tunnel Recess
Section

Design for Single-Screw Motor Cargo Vessel with Camellaird-Fullagar Engines.

### Fuel.

The fuel used would have a gross calorific value of 19,000 B.Th.U. per lb., and, as already stated, the engine would operate for long periods on many boiler fuels, but at a slightly higher consumption as, in addition to the inferior heating value, the combustion properties of such oils are not so good.

The total weight of machinery in the engine room would be approximately 430 tons, but if higher piston speed common to other engines were adopted, this figure could be considerably reduced. As it is, it represents a saving in weight of about 70 tons over similar steam-engine installations. The weight given includes main engine, auxiliary Diesel engines, pumps used as stand-by to those on the engine, all ship's pumps, fuel tanks, and all systems in connection with the main and auxiliary engines.

For actual performances of Camellaird-Fullagar engines at sea, the fuel cost would be 0·00402 pence per ton-mile with Diesel fuel oil at 80s. per ton. With boiler fuel oil at 60s. per ton the cost would come down to 0·00317 pence per ton-mile.

## No. 3.—The Doxford Opposed-piston Marine Oil Engine.

By William Doxford & Sons Limited.

William Doxford & Sons Limited, Sunderland, submitted the following plans (Page 68 and Figs. 3 and 4) and description of machinery arrangement for discussion.

The installation consists of a single-screw three-cylinder unit of 540 mm. (21¼ in.) diam. and two by 1,080 mm. (24½ in.) stroke.

The engine is of the Doxford opposed-piston two-stroke type operating on solid injection.

The double-acting scavenging pump, and the necessary auxiliary pumps for making the engine self-contained at sea, are driven by levers from the centre cross-head of No. 2 cylinder.

Aft of the engine are arranged on a combined baseplate, which is bolted direct to the main engine bedplate, a Michell thrust bearing a three-throw high-pressure fuel-oil pump and a flywheel.

There are two camshafts, one in front of the engine for going ahead and astern, and one at the back of the engine which is operative only when going ahead. Both camshafts are driven by spur and bevel gearing from the thrust shaft.

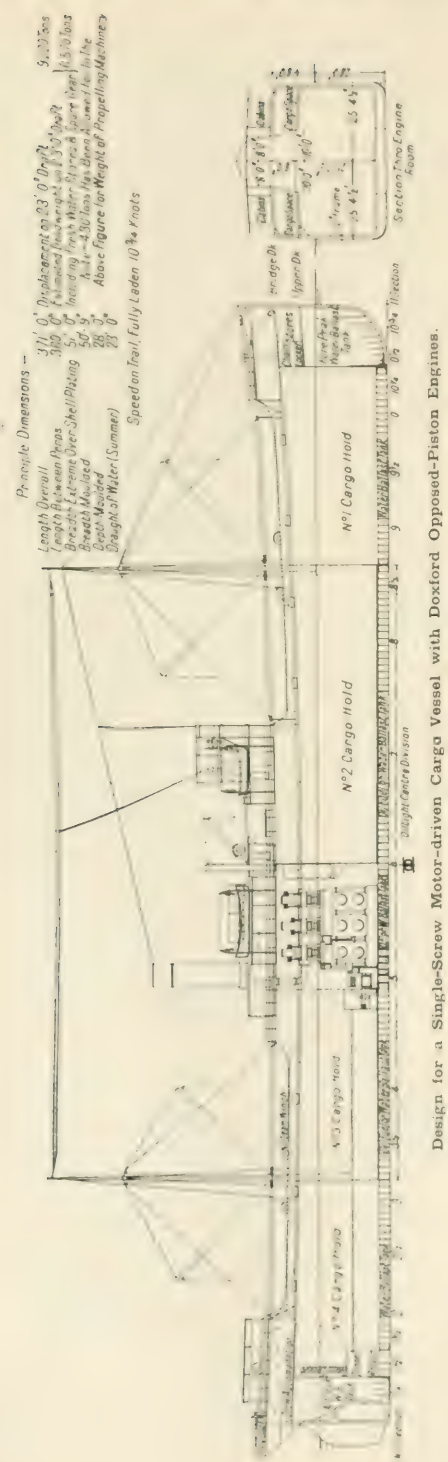
The crankshaft is of the built-up type, and so arranged that the shaft for each cylinder can be removed without having to dismantle other parts of the engine. In case of need the crankshaft for any one cylinder can be lowered into the crank pit and replaced by a straight length of shaft. In this case only two cylinders would be operative.

Forced lubrication is applied to main bearings, connecting-rod bearings and cross-head guides, while each piston is so lubricated at six points around the cylinder.

Each cylinder is provided with two fuel-injection valves, one air-starting non-return, and one relief valve.

Fresh-water cooling is used for cylinders, pistons, and cylinder valves, whilst sea water is used for the cross-head guides and for cooling the fresh water in a tubular cooler.

Two machinery arrangements are submitted, one with steam auxiliaries and one with electrical auxiliaries. In each case the minimum length of engine

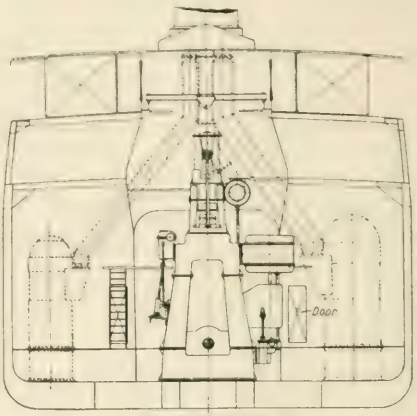

Principle Dimensions —
Length Overall 371' 0"
Length B'tween Perps 360' 0"
Breadth Extreme Over Shell Plating 54' 0"
Breadth Moulded 54' 0"
Depth Moulded 28' 0"
Draught at Water (Summer) 23' 0"
Displacement on 23' 0" Draught 9,000 Tons
Estimated Deadweight on 23' 0" Draught 6,500 Tons
Indicating Fresh Water Power at Sea (Year) 1,500 I.H.P.
Above Figure for Weight of Propelling Machinery
Speed on Trail, fully Laden 10¾ Knots
Section Thro Engine Room
Bridge Dk
Upper Dk
Shelter Deck
Main Deck
Water Ballast
Double Bottom
Engine Room
Boiler Room
No 1 Cargo Hold
No 2 Cargo Hold
No 3 Cargo Hold
No 4 Cargo Hold
Midship Section
Midship Centre Division

Design for a Single-Screw Motor-driven Cargo Vessel with Doxford Opposed-Piston Engines.

room of 40 ft. fixed for this vessel, to come within the 15 per cent. for light and air space has been adopted.

## Steam Auxiliaries.

The plan of the ship proposed for this review shows the donkey-boiler on deck. This arrangement has in numerous cases been the practice with steam-propelling machinery, but it should be borne in mind that it was only on rare occasions that the donkey-boiler was called upon to



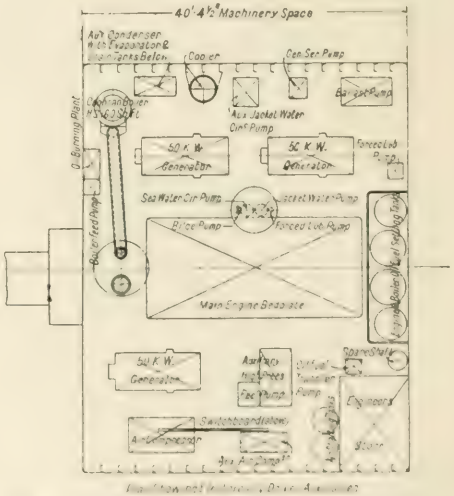




Fig. 3. Single-Screw Arrangement with Doxford Opposed-Piston Oil Engine.

operate. The case is different with a motor installation, where the donkey-boiler virtually becomes the main boiler, and, as such, its proper place is in the engine room, and preferably accessible from the engine-room floor.

This arrangement shows the boiler split up into two units, a larger and a smaller one, the former serving for harbour use while the latter will serve at sea for supplying steam for accommodation, steering gear, electric-lighting set and whistle.

## Electric Auxiliaries.

Three electric generating sets are proposed, each of 50 kw., D.C., 220 V. direct-coupled to a two-cylinder oil

engine. Two of these would be required for harbour use to drive electric winches, and one would serve at sea for electric light and steering gear. An 8-kw. converter is required for the electric-light service to reduce the voltage from 220 to 110. A syren worked by compressed air from the starting-air bottles would take the place of the steam whistle. A small motor-driven compressor, which would come well within the capacity of one generating set, would serve to press up the air bottles periodically.

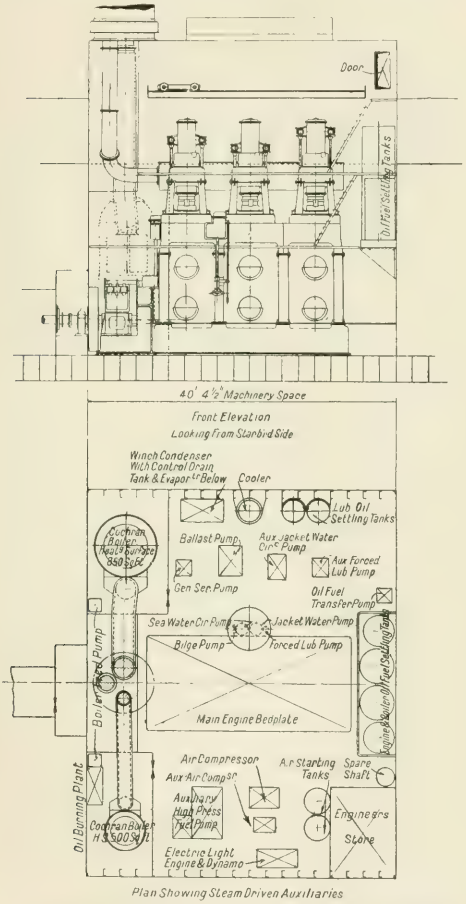



**Fig. 4.—Single-Screw Arrangement with Doxford Opposed-Piston Oil Engine.**

A small donkey-boiler would serve to heat accommodation and fuel oil (if necessary) and also to warm up the main engine prior to starting up.

*(To be continued.)*

J. & D. MORRIS. At Newcastle County Court recently, an application was made on behalf of Richard Irvin & Sons Limited, North Shields, for the winding up of the company J. & D. Morris, shipbuilders and shiprepairers, Pelaw Main. It was stated that an effort was being made to reorganise the company and that if an adjournment was given probably the debentures would be taken over and the company would be able to pay 20s. in the £. The judge declined to grant an adjournment and made an order for the winding up of the company.

## A QUICK BOILER REPAIR AT CHANAK.

**(From a Correspondent.)**

During the recent landing of troops, at Chanak, and also during the evacuation, the whole of the water transport came under the orders of the senior transport officer, who was also the captain of the evacuation cruiser H.M.S. *Centaur*. The ship's engine-room staff kept the whole of the fleet auxiliaries in working order, of course working far above the usual routine hours. The pumps supplying the fresh water to the town (these were in the Turkish lines) were also refitted by the R.N. Shortly after the refit of the pumps, an urgent message was received by the military, asking assistance, as the only remaining boiler had given out. An engineer officer left the ship at 8.30 a.m. to inspect the damage (having obtained an old Ford van for transport). The furnace-front was right away from the boiler, its only support being a bent fire-bar, the proper steel supporting bar being missing; probably having been removed by the Turks. The whole of the front brickwork, and half the side brickwork, was deficient and required renewal, as it was extremely liable to fall down at any moment. The front casing door was right away from the boiler, leaking badly, and sand and fireclay had been roughly packed round this in order to try and prevent waste of heat. All the boiler mountings required refitting. One water-gauge glass was missing, and the other, owing to its filthy condition showed a false water level. There were no stores of any kind except a pile of broken bricks and bent fire-bars. The engineer officer returned on board with all despatch, and arranged for the necessary stores and engine-room ratings to leave the ship as soon as possible. The party landed at 12.0 noon and transported the stores, &c., to the Ford van, the pumping-house being reached at 1.30 p.m. As water was urgently required for the troops and town, it was necessary to keep steam till the supply reservoir to the town was pumped full; the town supply being shut off, in order to keep a supply of water in case of emergency. At 3.30 p.m. steam was down and the boiler shut off. The brickwork was removed while still red-hot. Luckily a discarded furnace-front was found in a shed, and as this was in good condition it was utilised. As soon as steam allowed, the boiler was opened and examined internally, and from its condition it is impossible to imagine how the boiler had functioned at all. The blow-down cock was choked solid, and had to be drilled out. Every boiler mounting leaked, and the steam stop-valve was found *upside down*. The front casing door was removed, and thick asbestos jointing was fitted round to form a fire-tight joint. All the fire-bars were found bent and quite useless, but an emergency set was found from a heap of many hundreds, straightened, and fitted. All the accumulated dirt was removed from the interior of the boiler, and all parts accessible were scrubbed with wire brushes. The brickwork was completed at 4.30 a.m., and shortly after the boiler was closed up except the top door. As there were no mechanical means of filling the boiler with water (steam being down), this had to be done by means of old cans from a well outside the pump-house, and necessarily took a considerable time (this operation was watched by the Turkish soldiers, who, fully armed, climed the surrounding trees to obtain a better view). At 5.30 a.m. the boiler was filled to working height and the fires were lighted; and when the boiler was found correct the reserve water supply in the reservoir was opened to the town. At 6.45, as steam allowed, the water-pumps were tried with satisfactory results. It was estimated that the boiler should now run for four months, providing ten hours per month were allowed for internal cleaning. Lubricating oil, waste, packing and jointing material, fire-bricks, as well as a supply of water-gauge glasses were supplied by the ship. It must be mentioned that the pumping-station and boiler-house were outside the British lines and in Turkish territory, so that the urgency of the repair can be understood.

# MARINE DIESEL ENGINES—RUNNING CONDITIONS AND OPERATING SYMPTOMS*—II.

**Bottom Platform Details—Air Compressors—Operating Symptoms—Starting and Manœuvring.**

(Continued from page 20.)

Referring to a knock which may only be heard from the position of the bottom cylinder cover, it is well to investigate the source at once. A light noise, more in the form of a click, will be made if a piston ring is broken and will occur towards the top and bottom of the stroke as the crank approaches and turns over the centres. Then it is possible to get a very light combustion knock which will be almost or entirely inaudible at the cylinder head due to the noise made by the valve gear. This is located easily since it can only occur at or about top centre during the firing stroke and can be confirmed by taking an indicator card, when the cause will be seen and can be remedied.

In passing along the middle platform it is advisable to occasionally feel the temperature of the starting air pipes where they join the cylinder heads. Any increase in temperature means that a starting air valve is leaking and that the combustion gases are passing back along the pipe. Of course, should the leakage be excessive, other indications would exist in addition to this, but it is better to make the discovery before much damage is done. A slight leakage can, as a rule, be cured merely by turning the valve on its seat a few times.

When it is an air injection engine with the air compressor driven off the main engine, it is usual to find at least the H.P. aftercooler on the middle platform level, while in all probability the I.P. and L.P. inlet and discharge pipes will be accessible from there as well. In connection with these, close observation is necessary if the best results are to accrue. It is unusual to find the compressor stage temperatures being read and recorded by thermometers when a ship is at sea in normal operation, but it is a practice that might well be inaugurated resulting in the ultimate reduction of maintenance costs. As matters stand at present, it is possible that most harm is caused to valves and springs by the unbalanced state of the stages when operating at nominal output, resulting in increased temperatures being encountered which finally carbonise the lubricating oil on the valves and remove the temper from the [illegible]

## Bottom Platform.

On this level the main interest centres around the starting platform with its component gauges and recorders. Of these, reference may be made to the following points :—

*Lubricating Oil Gauge.*—The pressure, usually controlled at the lubricating oil pump, only denotes the force of the oil before entering the main bearings, so that observation of the highest point of delivery in the lubricating oil system is necessary to ensure adequate distribution taking place throughout. The lubricating oil pressure is mainly governed by the condition of the main bearings, to which it is first delivered from the pump, so that it would be quite possible to have considerable oil loss from bottom and top-end bushes, resulting in an inadequate supply going to the guides, &c., and yet the gauge pressure [illegible]

A secondary gauge is usually fitted at the pump, and, in the case where the filters are arranged between the pump and the engine, comparison of the two gauges will denote the condition of the filter. Where the filter is arranged on the suction side of the pump, the condition of it can be ascertained by noting what additional amount of opening of the S.L. suction valve is necessary to maintain the desired pressure.

*Cylinder Jacket Cooling Water Gauge.*—This pressure is affected by control between the circulating pump and the inlet pipe to the jackets, and, once this is set, by readjustment of the discharge valves on the cylinder heads. It is unlikely to be affected by any untoward happening such as slight leakage from the combustion side into the water space, this, more probably, being detected by inspection of the overhead discharge. Silting in the water passages tending to choke them would ultimately show on the gauge, but this trouble would be more readily detected by signs of overheating which would become manifest ere a pressure difference was noticed.

*Piston Cooling Water Gauge.*—Pressure control is effected on the suction side of the piston cooling pump and by regulating valves at the inlet to each piston. Variation is attributable to the filters, the same indications existing as in the case of the lubricating oil pump, since a secondary gauge is also fitted to the piston cooling pump.

Since the resistance pressure depends entirely on the regulating valves at the inlets to the pistons, the engine pressure gauge is only arbitrary and will not record defects in the system other than the state of the filters. Any defect arising, such as a cracked piston, would only be detected by inspection of the piston cooling water return pipes, which, in this case, would show traces of escaping gases. Of course, other indications of this mishap would at once evidence themselves if the crack were of any magnitude, but a slight leakage might first be detected from the source of the piston cooling return water.

*Blast Air Gauge.*—Assuming the main engines to be running at normal output with the air compressor suction regulated, then control of the blast air pressure is mainly effected by adjusting the blow-off to the starting-air reservoirs, and, when these are fully charged, by allowing the surplus to escape to the atmosphere. Variation of blast air pressure, apart from the blow-off, may be due to air compressor faults, in which case verification can be had by reference to the air compressor gauges, or to defects arising in the fuel injection valves. A gradual but persistent increase in pressure would be accounted for by a choked atomizer in one of the fuel valves, or might be due to an alteration occurring in the roller clearance of one of the same valves. Either case would probably be accompanied by a falling off in engine speed when the cause could be verified, first by examination along the camshaft to ensure that all clearances were apparently correct, and then by taking a set of indicator cards to check the conditions prevailing. If rough weather was being experienced at the time, it is possible that a drop in engine speed might be attributed to it, so that the blast pressure would form the best indication under the circumstances.

A decrease in blast pressure, necessitating reduction of the quantity of air blown off, may be due, apart from compressor troubles, to a leakage having developed at one of the various joints in the pipe line or at a fuel injection valve itself. The most usual source of loss is due to leaking packing glands in the fuel injection valves, but such packing glands are already becoming things of the past.

A leaking fuel valve will cause a gradual drop in the blast pressure, but when it extends to any magnitude, the effect will become pronounced and is likely to be traced from other sources.

* [illegible]

A fuel injection valve that is leaking badly causes pre-ignition due to a higher compression pressure, formed by the blast air entering the cylinder continuously, thus giving a higher initial pressure at the start of the compression stroke; also by the fuel being blown in as soon as it is delivered from the pump to the injection valve. The defect will also be recorded by traces of smoke in the exhaust.

*Pyrometers.*—These consist of thermo-couples placed as close as possible to the exhaust valves in each cylinder, while the wires are led into an interpole switch and the readings are taken from a common dial.

Pyrometers are invaluable for denoting the condition of the exhaust valves, if used in conjunction with indicator cards, while the balance of the engine can be approximated also by their use, provided the condition of the valves is known. For instance, if the exhaust temperature of any one cylinder was observed to be lower than normal, it would probably be found that the cylinder was low in output due to fuel admission, or loss of compression due to piston rings or sources other than the exhaust valve. If the temperature were above normal, then the cylinder would be overloaded or fuel injection be late, or else the exhaust valve would be leaking. With a leaking exhaust valve a higher pyrometer temperature would be recorded even though the fuel distribution to that cyclinder was less than its neighbours. This, of course, is due to the escape of gases right through the firing stroke. Therefore, if all valves, piston rings, and cylinder joints were known to be tight, uneven pyrometer readings would draw attention to fuel injection and load balancing conditions.

## Air Compressors.

Some idea of the operating symptoms of an air compressor can be gathered from the following notes :—

*Valves.*—(1) Should the L.P. suction valve be choked the L.P. suction gauge will record a vacuum, accompanied by a drop in all stage pressures.

(2) Should the L.P. suction valve be leaking, indication will be given by the noise of blow-back at the air intake.

(3) Should the L.P. delivery valve be choked, the L.P. cylinder will experience a higher terminal pressure, but the L.P. gauge will record a lower pressure than normal, since the gauge is connected on the delivery side. The effects on the compressor will be to give a high L.P. delivery temperature accompanied by a low I.P. gauge pressure and reduced output.

(4) Should the L.P. delivery valve be leaking, the defect will show on the L.P. gauge, since during the compression stroke the pressure will rise, while on the suction stroke the pressure will fall rapidly due to some of the remaining air in the L.P. intercooler passing back into the L.P. cylinder. As the leakage develops, or should the valve break, the L.P. terminal pressure will drop, since the air passing back into the cylinder on the suction stroke will prevent the L.P. suction valve from opening properly. The I.P. gauge pressure will also drop while the H.P. delivery temperature will rise.

(5) Should the I.P. suction valve be choked, the L.P. gauge pressure will rise due to the increased resistance, while the I.P. gauge pressure will drop and the output of the compressor be reduced.

(6) Should the I.P. suction valve be leaking, the L.P. gauge pressure will rise since the L.P. stage is doing normal work; while the I.P. stage is not delivering its full output during the compression stroke, the I.P. gauge pressure will fall and the compressor output will be reduced.

(7) Should the I.P. delivery valve be choked, the I.P. gauge pressure will fall due to lack of supply, while the L.P. gauge pressure will rise due to the increased resistance.

(8) Should the I.P. delivery valve be leaking, the I.P. gauge pressure will fall due to the air from the I.P. intercooler entering the cylinder on the suction stroke, thus reducing the amount taken from the L.P. intercooler, with the result that the L.P. gauge pressure will rise as the machine is tending to become a two-stage compressor. So long as the intercooler relief valves do not lift the output will remain unaltered, although all temperatures will rise considerably.

(9) Should the H.P. suction valve be choked, the I.P. gauge pressure will rise due to increased resistance, while the L.P. pressure will gradually rise owing to less air being drawn by the I.P. cylinder, since the amount of air in the clearance space of the I.P. cylinder at the end of its compressor stroke is at a higher pressure, and will, accordingly, expand to greater volume during the suction stroke. This will limit the amount of air passed from the L.P. stage, with the result that the L.P. pressure will also rise.

(10) Should the H.P. suction valve leak or break, the I.P. gauge pressure will rise rapidly accompanied by a rise in the L.P. gauge pressure, since the machine would again tend to become a two-stage compressor, this time with the I.P. cylinder acting as H.P. stage. The relief valves would, of course, prevent this actually happening.

(11) Should the H.P. delivery valve be choked, the I.P. and L.P. gauge pressures will rise gradually, due to the increased pressure at the end of the compression stroke of the H.P. cylinder, with its ensuing expansion to greater volume preventing the correct volume of air passing from the other stages, and so increasing the pressure in them. The output of the compressor would also drop.

(12) Should the H.P. delivery valve leak or break, the machine would tend to become a two-stage compressor just the same as the case of a broken H.P. suction valve.

*Piston rings.*—(1) Should the L.P. piston rings be defective, then on the L.P. compression stroke some of the air would get past them into the I.P. cylinder, although this would not matter. On the L.P. suction stroke, however, which is also the I.P. compression stroke, some of the I.P. air would escape back to the L.P. cylinder and so lower the volumetric efficiency with a consequent drop in output. If the leakage were only slight, the L.P. pressure would remain about normal or slightly higher, but the I.P. pressure would drop.

(2) I.P. piston-ring leakage would mean the escape of air to the crankcase with a reduced I.P. gauge pressure.

(3) Should the H.P. piston rings leak, the L.P. gauge pressure would rise and the output of the machine would drop considerably. If such leakage develops to any extent the L.P. relief valve will blow off intermittently. It will be found that the L.P. gauge pressure rises excessively on each compression stroke until the relief valve opens, when the pressure will instantly drop to considerably less than normal, while several strokes will be required to again raise it to the blowing-off point.

*(To be continued.)*

## Design and Construction of Marine Boilers.

The following modifications to Part I, Section IV of the Standard Conditions for the design and construction of Board of Trade Marine Boilers, have now come into force :—

*Clause* 2 to read—"*Single-ended Boilers*: All single-ended boilers, 16 ft. mean diameter or over, shall have a glass water gauge on each side. Single-ended boilers under 16 ft. in diam. shall have one glass water gauge, and one set of test cocks, or the equivalent of the latter."

*Clause* 3, *para.* 1, to read :—"*Double-ended Boilers*: All double-ended boilers shall have a glass water gauge at or near each end, on opposite sides, and a set of test cocks at each end or the equivalent of the latter."

*Clause* 13, *lines* 6 *and* 7 *of para. relating to size of Safety Valves*, to read: "Aggregate area of safety valves in square inches = Total heating surface of the boiler in square feet $\times \frac{(K)}{(p + 15)}$,"

*Clause* 14 to read :—"*Waste Steam Pipe*: The waste steam pipe and the passages leading to it should have a cross-sectional area not less than 1·1 times the combined areas of the safety valves as given by the above rule."

# THE NOMENCLATURE OF OIL ENGINES.

**Report of the Committee appointed by the Institution of Mechanical Engineers.**

During the discussion arising at the Lincoln Summer Meeting of the Institution of Mechanical Engineers in 1920 on a paper by Mr. F. H. Lavers, entitled "Some Lancashire Oil Engines," a number of members commented upon the prior claims of Mr. Herbert Akroyd Stuart to be acknowledged as the pioneer of the modern heavy-oil engine and as to the inadmissibility of the term "Semi-Diesel" to describe the type of engine developed from his invention. In his concluding remarks the President, Captain H. Riall Sankey, C.B., C.B.E., announced his intention of suggesting to the Council that a Nomenclature Committee be established for oil engines "to deal with the question generally."

The Council appointed such a Committee, which consisted originally of Captain H. Riall Sankey, C.B., C.B.E., *President (Chairman)*; Mr. F. H. Lavers, *Member of Council (Deputy Chairman)*; Mr. A. E. L. Chorlton, C.B.E., *Member of Council*; Mr. Longhurst Pendred, *Member of Council*; Mr. William Reavell, *Member of Council*; Prof. William Robinson and Mr. W. A. Tookey. The following subsequently accepted invitations to serve on the Committee:—Brig.-Gen. R. K. Bagnall-Wild, C.M.G., R.A.F. (Aeronautical Inspection Directorate); Mr. Charles Day, *Member of Council*; Lieut.-Col. L. F. R. Fell, D.S.O., O.B.E., R.A.F. (Directorate of Research, Air Ministry); Eng. Vice-Admiral Sir George G. Goodwin, K.C.B., LL.D., R.N. (Engineer-in-Chief of the Fleet, *since retired*); Eng.-Commr. C. J. Hawkes, R.N. (ret.) (Professor of Engineering, Armstrong College); Dr. F. W. Lanchester (representing the Institution of Automobile Engineers); Mr. E. W. Petter, *Member of Council*; Mr. Geoffrey Porter (representing the Diesel Engine Users' Association); and Mr. C. G. Roberton (representing Messrs. Vickers Limited) (*since deceased*).

Five meetings in all were held apart from the work of a small sub-committee consisting of Messrs. Chorlton and Tookey.

The following is the text of the report which, although dated November, 1922, was not issued until the middle of January:—

1. The Committee has given consideration to various suggestions and schemes of nomenclature emanating from the chairman, individual members and from its sub-committee; to correspondence and pamphlets addressed to it by Mr. Herbert Akroyd-Stuart; to dossiers submitted by the Admiralty and the Department of Scientific and Industrial Research; to representations from the British Engineering Standards Association; and to replies to enquiries, made on its behalf by Mr. Pendred, as to the existence or otherwise of approved nomenclature of oil engines by engineering institutions in France and in the United States of America.

2. The Committee is of the opinion that the modern oil engine, as distinct from the automobile type of liquid fuel engine, has been evolved mainly from the principles enunciated by Mr. Herbert Akroyd-Stuart in his Patent No. 7146 of May 8, 1890, and as embodied in the engine constructed at Bletchley (Buckinghamshire) and tested by Prof. William Robinson, a member of the Committee, in February, 1891. Prof. Robinson referred to this engine in detail in a paper, "The Uses of Petroleum in Prime Movers," read on April 29, 1891, and subsequently published in the Journal of the Society of Arts. This "Akroyd" engine is the prototype of those in which the liquid fuel is introduced into a compressed or partially compressed charge of air, and which do not need an extraneous source of ignition. In this respect the "Akroyd" engine anticipated the engine subsequently evolved in Augsburg, Germany, by the Maschinenfabrik Augsburg Nürnberg from the original proposals of Rudolph Diesel in 1893, and described by H. Ade Clark in his paper, "The Diesel Engine," read before the Institution at the meeting in Leeds in July, 1903. It may thus be said that the pioneer work of Herbert Akroyd-Stuart has been adversely cloaked by nomenclature.

3. In the development of modern oil engines, departures have been made both from the "Akroyd" and the "Diesel" original principles, and to designate these by inventors' names would be misleading and depreciative of the work of those to whose efforts the recent successes achieved have been due. The various types of engines merge so intricately that arbitrary grouping for the purposes of nomenclature would be unsatisfactory. For commercial exploitation, trade names cannot be dispensed with, and after all these are usually sufficiently distinctive for general use.

4. The Committee considers that the term "Semi-Diesel" as applied to oil engines is subversive of the fact that this type of oil engine is a British production and an evolution from the "Akroyd" engine.

5. After careful consideration, the Committee has been forced to the conclusion that an extended classification would be of little value, and that it is improbable that any system of nomenclature could be devised to cover all divergent points of detail and to meet practical requirements.

## The Isherwood System of Ship Construction.

The progress returns for the "Isherwood" system up to the end of 1920 showed some remarkable figures regarding the number of orders placed, but a great falling off in shipbuilding generally has taken place since that time, which is reflected in the number of contracts made for vessels to be built on the "Isherwood" system during the past two years. The following table, however, cannot fail to be of interest, as, in addition to recording the number and deadweight tonnage of "Isherwood" ships contracted for in each year from 1907 to 1922, it shows to some extent the general activities of the shipbuilding industry during that period in which the "Isherwood" system has come generally into

A feature of special interest this year is the large number of vessels being constructed to the "Isherwood" design, 30 ships having left the stocks during the year, including oil barges, general cargo vessels and oil-tank steamers ranging in size from 83 ft. 3 in. to 550 ft. in length.

| Year. | Number of ships built, under construction, and on order. | Deadweight carrying capacity. Tons. |
|---|---|---|
| Sept., 1907, to Dec. 1908 | 6 | 31,608 |
| 1909 | 36 | 212,992 |
| 1910 | 76 | 484,752 |
| 1911 | 140 | 958,795 |
| 1912 | 240 | 1,777,348 |
| 1913 | 270 | 1,993,034 |
| 1914 | 344 | 2,351,322 |
| 1915 | 468 | 3,548,221 |
| 1916 | 620 | 4,666,090 |
| 1917 | 800 | 6,332,150 |
| 1918 | 1,050 | 8,797,700 |
| 1919 | 1,260 | 10,594,700 |
| 1920 | 1,395 | 11,962,400 |
| 1921 | 1,418 | 12,032,400 |
| 1922 | 1,431 | 12,101,890 |

# THE GENERAL MANAGEMENT AND WORKING OF WATER-TUBE BOILERS IN MERCHANT SHIPS—I.

**Need for Careful Firing—Advantages of Water Tube Boilers—Management.**

Probably the greatest factor in the successful running of water-tube boilers is "management," and by this is meant correct firing and accurate feeding. Fifteen, or even ten years ago, the automatic feed regulators fitted, although reliable up to a certain point, could not be compared with the accurate and almost fool-proof regulators now in use; consequently, unless the boiler-room crew were very highly trained, as in the Royal Navy, they were liable to panic should the automatic feed refuse to operate, and the feed water suddenly disappear in a group of boilers. With the advent, however, of absolutely reliable automatic feed regulators, the question of correct feeding and water level has been solved, providing, of course, the boiler is designed correctly. Another point in connection with the feeding must also be noted. In a big merchant ship a junior engineer would probably be in charge of each boiler room, whereas in the naval service, in a ship of, say, 50,000 s.h.p., one junior lieutenant or warrant engineer is in charge of the whole watch, the feeding in each boiler room being the sole duty of a chief or petty officer.

## Need for Careful Firing.

In considering the running of the water-tube boilers in merchant ships, the great point the fireman must be made to understand is the need for uniform and careful firing. Once he thoroughly understands this fact, he will appreciate that the more carefully he fires the less labour is entailed; further, the risk of brickwork giving out or tubes distorting is reduced, so that less repairing is called for. A point which will appeal to owner and engine-room staff alike is the accessibility of the water-tube boiler for cleaning and repair, and also the ease with which the majority of repairs can be effected. In the French mercantile marine the water-tube boiler has been in use for a great number of years, and the chief engineers of a number of ships, who were questioned as to the working and management of these boilers, considered them far superior to the cylindrical marine boiler for merchant ship work.

It is not, of course, contended that the water-tube boiler is ideal for tramps or the smaller cargo steamers, at least not the present types; but for ocean liners and large cargo steamers the modern water-tube boiler, especially if fitted to burn oil fuel alone, or oil and coal combined, has many features which, theoretically at least, make it superior to the cylindrical marine type. Many owners and marine engineers still seem to regard the water-tube boiler as being most complicated and intricate, whereas exactly the opposite is the case. As will be remembered, it was a difficult matter to induce the Admiralty to install water-tube boilers in the Fleet, and there is no doubt that some of the earlier naval types left a very great deal to be desired, but the present types seem to answer all requirements, and a boiler that will readily respond to variation of speed, as required in the Royal Navy, should prove suitable in the mercantile marine, where a steady, uniform speed is the order of the day.

## Advantages of Water-Tube Boilers.

As regards auxiliary work in harbour, when no donkey-boiler is fitted, it becomes necessary to use a main boiler for deck machinery, and lighting. In practically every case the amount of steam generated is greatly in excess of requirements. Where water-tube boilers are fitted this loss is prevented, the units being much smaller, a greater number are fitted, and boilers can be shut off or put on easily and quickly. Again, in warming through main engines an extra boiler is sufficient, the remainder of the generators for the speed required being connected a short time before the vessel sails.

## Management of Water-Tube Boilers.

With water-tube boilers it is essential that fresh water only is used for feeding, and, if possible, the water should be distilled. In any case, the water must show clear with the silver nitrate test, and the sensitive hydrometer must also be employed to detect presence of salt water. The best practice is to keep the water slightly alkaline by the addition of lime or soda. In naval practice the feed water is tested for acidity by the phenolphthalene test. The boilers to be steamed should be run down to not more than a third of a glass, some engineers tying a piece of asbestos cord round the gauge glass at the required height. The air cocks on top of the boilers are kept open until steam actually blows through, and, with new boilers, or in boilers in which the brickwork has been repaired, steam should be raised very slowly. In any case, in merchant vessels, two to three hours should be allowed. The fires must be kept very light and thin, to prevent distortion of fire bars, and no holes in the fire must be allowed until the engines are under way.

The water gauges, automatic feeds, safety valve easing gear, and auxiliary feed pumps should be tried, and in boilers fitted with small doors, such as Babcock & Wilcox, and Belleville, any doors which have been removed for rejointing or examination should be carefully tightened. If a boiler has not been steamed since the last cleaning, all doors which were removed should be slowly tightened up when raising steam, if necessary letting steam down and rejointing. Joints in Niclaussé boilers must not be tightened up when the boiler is working. With water-tube boilers extreme care is necessary in connecting up, and great care should be given to the drains, all stop valves being opened slowly and carefully, since fatal accidents have occurred owing to lack of care in connecting up groups of boilers. Stop valves should be opened in proportion to their distance from the engines, and a small amount of wire-drawing to the steam should be allowed. A good plan is to carry a pressure of about 10 lb. per sq. in. less in the H.P. receiver than shown on the boiler gauge.

## Firing.

The management of oil-fired boilers has often been fully described so that it is only necessary to consider coal firing. It is a most important point to fire up at equal intervals, this being absolutely essential if a steady steam pressure is to be maintained, this being conducive to economical running. The usual practice is to number or letter corresponding furnace doors in each boiler room consecutively, and the furnaces being fired in numerical order. The interval between the firings will, of course, depend on the steam required, but in the merchant service this should easily be ascertained. In the Navy, where the speed constantly varies, indicators are used, Kilroy's stoking indicator being the most common in use. Each shovelful should contain about 30 lb. of coal, and three should be put on at each firing. The ordinary rate of combustion per square foot of fire grate per hour should be about 16 lb.

It should be impressed on the firemen that a thick fire gives the worst possible result. With thick fires the air does not pass freely through the fire, and gas is formed which is not burnt in the furnaces, incomplete combustion results, and deposits are formed on the fire side of the tubes which greatly retard the transmission of heat. Thick fires also frequently cause overheating of uptakes, casings and funnels,

owing to gases igniting higher up in the boiler. Thickness of fires will depend on the steam required, but it is a safe rule, with bright fires, never to exceed 6 in. Should it be necessary to increase the normal speed, the rate of firing can be increased, but not the amount of coal thrown on at each firing. For the best results the coal should be broken up in 3 in. to 5 in. lumps, and firing should be done quickly, great care being taken to keep all coal well clear of the dead plates. When firing up, one man should open and shut the furnace door and another fire up, the fires being always worked from the back to the front. The absolute necessity of filling up all holes and keeping the whole of the grate surface at a uniform thickness should be impressed on the firemen. Draught plates should be opened only enough to supply the requisite air and it is better to have an excess air pressure in the boiler room and check by draught plates. Draught plates should never be fully opened, unless for removal of ashes, &c., as automatic self-closing ash-pit doors are liable to stick in the horizontal position should a tube fail. The best results are obtained when the draught plates are in an intermediate position.

## NEW CRAFT FOR SEPARATING OIL FROM BALLAST WATER.

The Oil in Navigable Waters Act, 1922, which came into force on January 1, has been responsible for the production of a separator barge, designed from the experience gained as the result of experiments carried out at Smith's Dock Company on the separation of scum from ballast water. The barge has been produced in conjunction with the Anglo-Saxon Petroleum Company, in order to obviate the necessity for a vessel having to proceed beyond the three-mile limit to discharge ballast water. The longitudinal section and two plan views are shown on page 61. The principle of operation is that of the surface separation of liquids of different specific gravities, the liquid having the lighter specific gravity rising to the surface. The barge is divided into a number of compartments by transverse bulkheads, the first being a receiving compartment. From this the liquid passes into another compartment, provided with a series of cones and baffles, while the bulkheads between the remaining compartments are arranged to form cascade filters. From the receiving compartment the oily water enters the cone filtering compartment, where practically all the scum is trapped by means of an intensive system of cascading and baffling, consisting of a number of superimposed cones terminating in the form of a bottle neck. The function of this is to reduce the free area of the scum which rises to the surface. When this accumulates in sufficient quantities in the bottle neck, it overflows into the scum trays surrounding the filter cone top and drains from there into the scum storage tank. The remainder of the ballast water passes on through the cascade filter compartments, which are made up of a number of transverse bulkheads extending from side to side of the barge, each having a horizontal slot at the top and bottom alternately, the slots running the full breadth of the bulkheads. The compartments are partially closed at the top by a sloping plate, which constricts the free surface as much as possible, so that the scum which may rise to the top is accumulated on a relatively small area instead of on a large one. By this arrangement the thickness of the scum floating on the surface of the water is increased and rendered more removable. The barge is fitted with a Hayward-Tyler pump, which can draw from the river, from the filter compartments, or from the scum storage tanks, and deliver to a deck connection, from which there are two branches, one leading to the filter compartment and the other delivering ashore. It is found that the scum does not seriously extend beyond the fourth cascade opening, and can then be dealt with by hand. Heating coils, fitted in the storage tank, allow of the scum being heated and settled. The separated water is pumped from the bottom of the tank through the cone filter until practically nothing but pure oil remains. This can either be delivered back to the ship or ashore, as desired. Some successful trials were carried out with the oil tanker *Corbis* recently, and many authorities expressed themselves satisfied with the barge's performance.

## THE "FARADAY."—A VETERAN CABLE SHIP.

The next few months will witness the passing of a veteran ship which has performed nearly half-a-century's arduous work in connection with the laying and repairing of submarine cables. This is the cable-ship *Faraday* owned by Siemens Bros. & Co. Limited, of Woolwich. She is shortly to be replaced by a vessel embodying the latest practice in cable-ship design now being constructed by Palmers Shipbuilding & Iron Company Limited, Hebburn-on-Tyne. On page 62 we reproduce some photographs of the present vessel, taken a few days ago as she lay at the West India Docks, where she is being used as a store-ship. The *Faraday* is an iron ship of 5,052 tons gross; she was built by Charles Mitchell & Co., Low Walker-on-Tyne, and was launched in 1874. She has a length of 360 ft., a breadth of 52 ft., and a depth of hold of 25 ft. Her three cable tanks have a total cable capacity of approximately 70,200 cubic ft.—two having a capacity of 47,712 cubic ft. each, and the other a capacity of 22,500 cubic ft. It is interesting to recall that, in spite of her age, the *Faraday* was in service as recently as 1921, when she laid a cable for the All American Cables Inc., between Cuba and Puerto Rico. Her first service was the laying of an Atlantic cable for the Direct United States Cable Company, in 1874. The hull differs considerably from that of the cable-layer of the present day, and she is somewhat unusual in that she is double ended and has an auxiliary rudder at her fore end. A thorough inspection of both engine and boiler rooms will take the observer back an era in the records of marine propulsion and leave him with a very profound respect for the work of marine engineers of fifty years ago. The main propelling machinery consists of two sets of compound reciprocating engines, each with its own condenser, arranged so that the two condensers are side by side between the two engines. The pumps are arranged between the engines at the forward and aft end and driven off the main engines. We reproduce on page 62 a photograph showing part of the *Faraday's* starboard engine—the pistons and connecting rods, the Stephenson-link motion-reversing gear, and the outboard ends of the drive to the pumps. Connection between the engine room and the boiler room is effected by means of a passage between the bunkers, on either side of which are the pumps for bilge and ballast purposes and for circulating water for the condensers when the main engines are not working. In the photograph will be seen a portion of the steam unit and its flywheel. Each of the main engines has a nominal horse-power of 536, and the boilers work at about 100 lb. per sq. in. pressure on coal fuel. The *Faraday's* successor will be a steel vessel approximately 380 ft. long, propelled by two sets of triple-expansion engines and having an oil-fuel capacity capable of allowing a cruising radius of approximately 10,000 miles. She will be fitted with four cable tanks with a capacity approximately 4,350 tons of cable

# NOTES FROM THE FOREIGN PRESS.

**Specially abstracted for "The Marine Engineer and Naval Architect."**

### Ship Derrick Design.

In many shipyards no technical consideration is ever given to the design of ship's derricks. A standard type of ship, and a more or less standard configuration of derrick have produced a type of derrick which has been found from experience to be satisfactory. Mr. Waldie Cairns, in a paper given some years ago before the North-East Coast Institution of Engineers and Shipbuilders, drew attention to the astonishingly crude methods by means of which derrick blocks and tackle scantlings were widely determined in practice. It will be remembered that Mr. Cairns's paper was largely responsible for the subsequent formation of the Ships' Details and Fittings Standardisation Committee of the British Engineering Standards Association. The present article has been largely written to show how the principal forces in a derrick system may be simply determined and thus incidentally to offer a simple means for interpolating the recommended scantlings drawn up by the Dutch Shipbuilding Standardisation Committee. The ordinary derrick is first dealt with and simple and accurate formulæ are derived for the thrust in the derrick and the pull in the topping lift. It is shown in this connection that for a given system of pulleys and a given ratio of length of derrick to height from heel to topping lift the thrust in the derrick is directly proportional to the load to be lifted, and is independent of the angle of the derrick. The pull in the topping lift depends upon the angle of the derrick and is a maximum when the derrick is horizontal. For a given height length ratio it is also directly proportional to the load to be lifted. The article deals further with the problem of the double derrick. This problem was very fully considered by Dr. Gütschow in 1921 before the German Society of Naval Architects. The problem is treated here very completely and a simple chart is given by means of which the forces in each derrick and their joint falls can be quickly determined. The article should prove of considerable assistance in enabling the recommendations of the standardisation committee to be scientifically interpolated.—*Het Schip*, January 12, 1923; p. 5; 4 pp.; 7 ff.

### Launching.

The operation of the launching of a ship is of such importance as to merit considerable technical consideration. As is well known it is in but few shipyards that this technical consideration is bestowed upon the problem. In this article—a contribution to the December meetings of the Italian Society of Naval Architects—the author outlines the possibilities for the application of technique in launching. A vessel to be launched safely should have ways of such declivity and extent that the smallest external starting pressure need be exerted to produce movement. The maximum velocity encountered together with the intensity of pressure between ways, should not produce burning of the lubricant and hence endanger the success of the launch. To obtain the desired technical control, previous launches should be analysed, declivities, lubricants, velocities and pressures all being taken into consideration. From the results of such an analysis the ways declivity in one yard averaged 7·5° and the pressure per square centimetre from 1·5 to 2 kilos. The maximum velocity was always found to occur at the point when the ship began to lift, *i.e.*, swing about the forepoppet. This maximum velocity ranged between 7 and 8 metres per second, *i.e.*, roughly from 14 to 16 knots. This velocity was found to ensure quite favourable launches. If, therefore, the usual launching calculations are gone through for any vessel to be launched, regard being had to the time of the year, the calculation can be made of the greatest assistance in deciding upon the conditions of the launch. In a yard building only one class of vessel, calculation will first of all justify or modify previous successful practice, but this done, it will rapidly usurp itself as routine work and become a very superficial calculation. In yards building diverse types it should always be retained.—*A. Cervuti, La Marina Italiana*, December, 1922; p. 353; 2 pp; 1 f.

### The Salvage of the "Avaré."

The literature of ship salvage has been very limited in the past. Such reports as were published being much more of the nature of incomplete descriptions rather than a technical exposition of the methods employed and the work accomplished. The present article on the salvage of the *Avaré*—which it will be remembered capsized on June 16, 1922, in Hamburg Harbour—is a very useful exception. The *Avaré* capsized after being withdrawn from the floating dock upon which it had just undergone survey. To ensure its stability its tanks usually had to be filled, but for the survey these had to be emptied and were only partially filled at the time of the accident. The vessel capsized parallel to quays, a fact which facilitated the salvage. The salvage proper was undertaken by the Bugsier, Reederei, Bergungs A.G., but the attendant structural and technical work was carried out by the Vulcan Werke, Hamburg. Heeling brackets were built above the ship's side and by means of cables hauled from the shore 100 metres away by means of winches. To secure the starting of the righting, the local salvage vessels and the Vulcan floating crane hoisted the vessel on the side opposite to the shore winches. The operation was carried out very successfully. All the technical work involved in the estimating of the requisite righting moment, the design of heeling brackets, the strengthening of the ship's side structure, the hauling cables is very fully gone into. When the ship was righted, sand ballast was placed in her and on pumping out the water she floated. This took place on September 7, 1922. The trim and displacement calculations in connection with this floating are also detailed. The article should prove of considerable value to those interested in the technical work involved in the salvage of ships.—*Dr. Probst, Werft Reederei Hafen*, December 22, 1922; p. 785; 11 pp.; 17 ff.

### Anchor Arrangements.

Anchor arrangements of practically all types of vessel have taken such a definite and generally satisfactory form that technical comment on their possible development would seem at first sight to be superfluous. However, the author, in a contribution before the Italian Society of Naval Architects, considers that improvement may be hoped for in the prime mover, *i.e.*, the windlass, in the thus resulting simplification of the system and finally, in the manufacture of the chain cables in view of the most recent researches into the fatigue of metals. The arrangements of some of the latest Italian liners are examined and their similarity commented upon. Steam windlasses are admitted as very satisfactory, but from a fuel standpoint a considerable amount of heat is lost due to the length of steam piping. With internal combustion engine-driven windlasses the unit becomes self-contained and is much more efficient from the point of view of fuel economy, but the difficulty of starting cold is a serious disadvantage, especially in view of the promiscuous use of a windlass. The best solution would appear to be the electrically-driven auxiliary, but here the difficulty of motor regulation is a serious objection. This objection is avoided by the use of the electro-hydraulic system as used in the Hele-Shaw and Williams-Janney types. This latter from experiments carried out by the British Admiralty would appear to be very suitable.

Finally the design of chains is considered and reference is made to the Gilchrist theory of fatigue and its confirmation by some experiments recently carried out at the Illinois University. With an alternating stress fatigue presents itself due to the lack of homogeneity of the material. Thus in the manufacture of chains, especial attention should be given to the homogeneity of the material and especially in way of the weld and its subsequent heat treatment.—*L. Fea, La Marina Italiana*, December, 1922; p. 342; 5 pp.; 7 ff.

### Electric Propulsion of Ships.

This article has been specially written to present the existing position of the subject. In Italy, where shipping is at a very low ebb, it is essential that whatever vessels are engaged in commerce should be the most economical possible. The article contains no experience which is new to English-speaking engineers and all of the descriptive portion of the article is culled from the British and American technical press. However, the subject is well treated and all aspects of the problem are dealt with very clearly. The turbo-electric and Diesel-electric systems are considered at length

and the usual arguments of increased weight and trained *personnel* associated with saving of cargo space and ease of manipulation and efficiency of propulsion. The question of the limitations to the application of power station experience to ship propulsion is also commented upon. The article is valuable inasmuch as it provides a fair and unbiassed examination of the problem, and is a reprint of the communications to the recent meetings of the Italian Society of Naval Architects.—*L. Fermi, La Marina Italiana*, December, 1922; p. 347; 6 pp.

### Ship Form Coefficients.

It is the practice of many designers to tabulate lists giving the [illegible] likely to be of service to them in their future work. Little complete data has been published in the past, but is contained in a scattered form in many journals throughout several countries. Much of this information has been summed up formulæ. In this article Prof. Scribanti gives a very comprehensive tabulated list of coefficients. The principal variable is the block coefficient, its value ranging from ·35 by increments of ·01, to ·91. For each value of the block coefficient are tabulated the values of the remaining coefficients with which it would be normally associated. These coefficients comprise the following: waterplane area, midship section area, prismatic, centre of buoyancy height, transverse and longitudinal radii of gyration of water plane, and transverse and longitudinal metacentric radii. These coefficients, although primarily intended for design work, will serve many purposes. They will be very useful for amplifying published data on a particular ship. They will also serve as a valuable check upon ordinary design work and displacement and hydrostatic calculations. The coefficients, although primarily culled from experience, have been carefully faired amongst themselves so as to fulfill their geometric inter-relations.—*Prof. Eugenio Scribanti, Rivista Marittima*, November, 1922; p. 371; 8 pp.

### Russian Inland Navigation and the Diesel Engine.

Although the Diesel engine is firmly established in marine practice, its entry into river vessels has been, up to the present, very insignificant. This may be due to the more remunerative nature of the marine work and to the difficulty of obtaining trained *personnel* for river work. However, it is now many years ago since the first Diesel engined vessel navigated the Volga. It is interesting to recall that in 1917 the tonnage of vessels plying the Volga and the West Siberian waterways amounted to over 690 passenger vessels and 1,300 tugs with steam installations amounting to roughly 800,000 i.h.p. and only approximately 100 Diesel or motor-engined vessels, having a total brake horse-power of 40,000. Vessels for long trips have been built up to 1,000 i.h.p. Practically all this tonnage is now dormant and much of it is useless. Paddle as well as screw Diesel vessels have been built for the Volga. One of the largest of these was the *Borodina*, built in 1911. This vessel carried 280 tons d.w. on a draught of 1·6 m. at a designed speed of 15 knots (deep water). The machinery consisted of two four-stroke Diesel engines of a total brake horse-power of 600. Each engine had six cylinders of diameter 410 mm., stroke 560 mm., the revolutions per minute being 240. A sister ship to the *Borodina* was built in 1915-16. These vessels carry about 1,000 passengers, in addition to the crew. Auxiliary machinery was generally steam driven, but the electric light dynamo was Diesel driven. Since 17 vessels in all have been built with Diesel engines, the earliest of these having had at least 10 years' service, there is sufficient proof that there is a great scope for new Diesel-engined river vessels on the Volga as soon as political conditions right themselves.—*R. Blumerius, Schiffbau*, December 20, 27, 1922; p. 190; 4 pp.; 4 ff.

### The Sulzer Two-Cycle Marine Engine.

In September last Engineer Commander Mercier read a paper before the Koninklijk Instituut van Ingenieure, Holland, on the Sulzer two-cycle marine engine. The subject is treated fully and after a general introduction on marine internal combustion engines, the Sulzer engine is discussed. Although Sulzers have built engines amounting to approximately one million brake horse-power, and roughly two-cycle and four-cycle engines in equal numbers, yet for higher powers both for land work and marine work the two-cycle is preferred. This is due primarily to the reduced weight and increased simplicity of the two-cycle type. The principle of the two-cycle is described, after which the scavenge pumps are detailed. Next the questions of mean pressure and piston speed are dealt with, and in the Sulzer engine the former is generally of the order [illegible] per sq. cm., and the latter between 3 to 4 metres per second, according to [illegible] the required peculiarities of the propeller. Heat stresses, cylinder covers and liners, pistons, manœuvring, reversing mechanisms, starting, air starting valves, fuel control and fuel consumption are all very fully considered. In connection with fuel consumption some interesting test figures are given. From the shop tests of two 1,700 b.h.p. engine the fuel consumption of main engines and auxiliaries were 181·1 and 184·9 grams per brake horse-power respectively. The "steaming weight" of a Sulzer marine installation, including propeller, shafting and normal auxiliaries is usually about 10 to 15 per cent. less than a corresponding steam installation of the same power with triple expansion engines and boilers. The various applications of the Sulzer land and marine engines are next outlined, and in particular the M.S. *Handicap* is described. Future developments are envisaged and the case of a liner of 22,000 tons displacement, 12,000 b.h.p. quadruple screw to be built by Messrs. Fairfield for the Union Steamship Company of New Zealand is of special interest. It is estimated that the annual running expenses of this vessel when completed will be £50,000 less than that of a corresponding steam installation. The article is well illustrated, and although in a Dutch periodical, is printed in English.—*J. L. Mesurier, De Ingenieur*, January 6, 1923; p. 1; 11 pp.; 25 ff.

### Shipbuilding Progress.

The author of this article has recently travelled through Denmark, Germany, Holland, Belgium, France and Great Britain, and has visited many of the leading European shipyards. This article forms a very interesting record of the author's observations and forms a comprehensive survey of the most recent developments in shipbuilding technology. The first point to receive attention is punching versus drilling, and the experience of the Furness Shipbuilding Company is largely drawn upon and referred to in this latter connection. England's foreign competitors are discussed, after which the present position of electric welding in this country is outlined, very full information being supplied. In this connection the motor coaster *Fullagar* is described and all the details of its construction, together with the present and general practice in electric welding constructional work are carefully considered. Next the construction of tankers is discussed, the Isherwood system and the F.K. system being especially mentioned. The duct keel is also referred to. Shipyard cranes, methods of erection and shipyard processes are finally dealt with. In this final section the Continental shipyards are well described. This article (which was read by the author before the shipbuilding section of the Swedish Technological Society) occasioned a very interesting discussion. In this discussion Prof. Lilliehöök criticised the F.K. construction and suggested that the deep girder used in this construction was very likely to buckle and in its stead he suggested the substitution of an equivalent girder of equal height, but with the centre portion of the web cut away. Many other interesting points were raised.—*Nils. J. Ljungzell, Teknisk Tidskrift*, 1922, Nos. 27, 30, 33, 36, 39 and 42; pp. 26; 86 ff.

### Engineering Education.

This article forms a very interesting exposition of the most recent German views on the education of engineers. By engineer is meant a university trained engineer. The modern tendency to widen the scope of training to embrace economics, industrial psychology, &c., in addition to the immediate professional subjects is evident in Germany as in other countries. The development of the seminar method of education and the encouraging of self-reliance is especially emphasised. Sympathy between the professor and the student is considered essential; and for this reason the author considers that a professor with sound psychological training is more to be desired than one of great professional training. Actual university training should be associated with works training, each occupying six months in the year. To secure the requisite collaboration between the industry and the university, the appointment of honorary professors from men eminent in industry is suggested. These, it is presumed would interest themselves in the work of the university and would occasionally deliver important lectures. In the works themselves the appointment of engineer lecturers is recommended. These would see that the student's practical training proceeded as rapidly and thoroughly as his technical training. The teaching of practical technique is one of the most neglected things in industry to-day. The selection of students for executive and administrative appointments is mentioned and their education and training is discussed. The article deals with the subject very thoroughly and is possibly indicative of the industrial and educational developments taking place in Germany to-day.—*Dr. Lippart, Z.d.V.d.I.*, December 16, 1922, p. 1109; 5 pp.

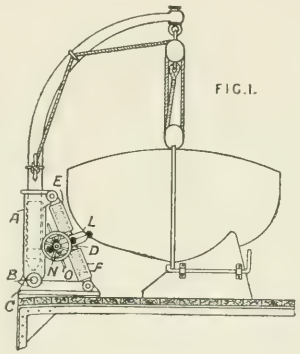
# RECENT PATENTS RELATING TO MARINE ENGINEERING.

Compiled by E. P. Alexander & Sons, Chartered Patent Agents, 306, High Holborn, London, W.C.

### No. 187,113. Ships' Davits.

*Moe, S.*, 12, *Kjöbmandsgaten, Trondhjem, Norway. September* 16, 1921. *No.* 24669. [*Classes* 78 (iv) *and* 115.]

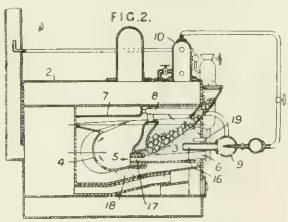
The davit support A which carries the davit in the usual manner is pivotally connected at its lower extremity to a fixed base plate C, and is luffed by a right and left handed screw spindle D working in sleeve nuts E, F pivoted respectively to the support A and base plate C. The spindle D is operated by a handwheel N through a worm and a worm-wheel keyed to the spindle D and enclosed in a casing L, which is prevented from rotating by stops O passing through lugs connected to the nuts E, F.

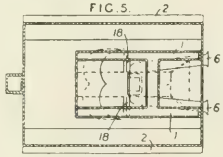



### No. 187,146. Steam Generator Furnaces.

*Ariura, M.*, 37, *Mukoyanagiwara-machi 1-chome, Asakusa-ku, and Ikehara, Y.*, 1, *Yayesu-cho, 1-chome, Kojimachi-ku, both in Tokyo. October* 28, 1921, *No.* 28695. [*Classes* 51 (i) *and* 123 (ii).]

A steam-producer 1 is arranged inside the inner shell of a boiler 2 and is provided with a grate 3 and a combustion chamber 5 having a twin hemispherical wall 4, against which gases from the passage 17 beneath the grate impinge. A portion of the gases pass into the perforated chamber 7, through water-jacketted pipes 8 to the steam-injector 9, supplied with steam from the dome 10 which is in communication with the generator 1. Air is supplied below the grate through inlets 19 and to the combustion chamber through pipes 6, and the returned combustion products are projected through the nozzle 16 on to the underside of the grate 3. Ashes and products of combustion escape from the combustion chamber 5 by the passage 18 to the ash-pan and chimney.

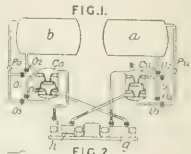


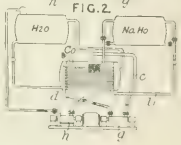




### No. 188,658. Steam generators and Engines.

*Marguerre, F.*, 32, *Augusta Anlage, Mannheim, Germany, and Hausmann, M.*, 30, *Xantenerstrasse, Berlin. November* 6, 1922. *No.* 30313. *Convention date, November* 11, 1921. *Addition to No.* 167,763. *Not yet accepted. Abridged as open to inspection under Sect.* 91 *of the Act.* [*Class* 123 (ii).]

In apparatus for storing and utilizing excess energy as described in the parent Specification, water is evaporated and steam is condensed in chambers separate from the storage chambers. Direct contact condensers or evaporators Cu, Co, Fig. 1, are connected to the low and high temperature storage chambers *a*, *b* by pipe systems in which are arranged pumps Pu, Po, and valves U1 ... U4 and O1 ... O4. When the turbine *h* is in operation, the valves U1, U4 are open and the valves U2, U3 are closed, water being drawn from the chamber *a* by the pump Pu and passed into the chamber Cu, where it is brought into contact with exhaust steam from the turbine. At the same time, the valves O1, O4 are open and the valves O2, O3 are closed, hot water being drawn from the chamber *b* and evaporated in the chamber Co. During the operation of the compressor *g*, the valves are reversed, and water is evaporated in the chamber Cu and steam condensed in the chamber Co. In a modification, lye is used in place of water in the low-temperature chamber NaHO. Fig. 2, and the separate evaporating and condensing chambers are replaced by tubular apparatus Co of the form of a surface condenser. During the working of the turbine, water from the chamber $H_2O$ is passed through the tubes of the tubular apparatus and lye from the chamber NaHO is passed over the tubes in contact with the exhaust steam from the turbine. During the working of the compressor, diluted lye from the upper part of the chamber NaHO is passed into the tubular apparatus through a pipe *l1*, steam being drawn off through a pipe *c* and forced through a pipe *d* directly into the tubes of the tubular apparatus.

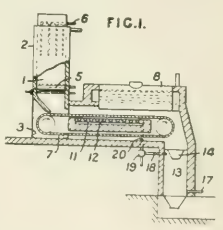



### No. 188,693. Furnaces.

*Bergh, S. V.*, 32, *Rorstrandsgatan, and Larsson, K. E.*, 2, *Heimdallsgatan, both in Stockholm. May* 20, 1921, *No.* 14153. [*Classes* 51 (i) *and* 51 (ii).]

In apparatus of the kind in which coke is discharged from retorts on to a chain or other mechanical grate and burnt beneath a boiler or the like, the retorts are heated independently of the products of combustion of the coke residue. As shown vertical retorts 1, arranged in a block 2 adapted to move on rollers 3 and heated by burners 5 located in passages between the retorts, discharge coke on to a chain grate 7 which passes beneath a boiler 8. The clinker and ashes from the combustion of the coke are dumped through a hopper 14 into a shaft 13, closed at the bottom and supplied through a pipe 17 with air which, ascending the shaft, becomes heated and passing through the outlet pipe 18 is forced by a fan or steam jet 19 into a pipe 20 and thence to flues 11 having outlets 12 arranged beneath the upper run of the chain grate. The products of distillation are withdrawn from the retorts through pipes 6 and passed either to the burners 5 or to a purifying plant. Steam or inert gas is supplied to the lower end of the retorts to form a seal.




### No. 188,717. Propelling ships.

*Gill, J. H. W., The Windmill, Heacham, Norfolk. July* 14, 1921. *No.* 19002. [*Class* 114.]

An anti-fouling device for screw propellers, axial flow impellers and the like, comprises an independent member, close to the intake side of the rotary member, provided with plates or blades which lie parallel to the direction of flow and arranged so that there is a progressive shearing action between the two members whereby weeds

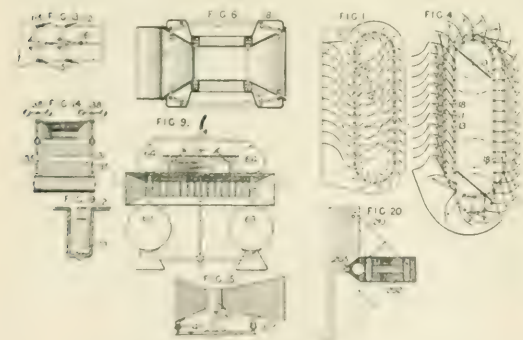
and like foreign matters are cut. The plates or blades may be connected so as to have a limited rotational or axial movement and may be spring controlled. In front of the blades B of a screw propeller, a plate or plates D, Figs. 1 and 3, are placed parallel to the direction of flow. When the trailing edges of the blades are straight the plates are parallel to a plane radial to the boss. Fig. 1, when the edges are curved the plates may be in a radial plane, Fig. 3. The plates may be fixed to the ship's structure or carried by bosses on the propeller shaft. In a modification, the plate D instead of being fixed is carried by a bracket O which allows of limited rotational movement under the restraint of a spring member P, Fig. 12, attached to a hull fitting Q.

FIG 12. FIG 1. FIG 3.

**No. 188,728. Turbines.**

*Feichtinger, A., 10, Josefstadt, Fri, Budapest. July 23, 1921. No. 19807. [Classes 110 (iii.) and 135.*

In an endless chain motor enclosed above and below by a casing 9, Fig. 1, the motive fluid is directed by the fixed guide blades 1, 4 so as to act successively on the oppositely moving rows of blades 3. In a modification, Figs. 4 and 6, wherein the intermediate guide blades 4 are dispensed with, two chain systems 18, 13 are employed so as to set the rotor blades 11 at the correct angle, the casing 12 enclosing these blades being given a converging form on the left



and a diverging form on the right so that the blades on the left act as reaction blades and those on the right as impulse ones. The motor may be arranged in the narrowest part 30, Fig. 15, of a tubular casing shaped like a Venturi tube. In this example, which is adapted to be operated by wind, the long arm 31*b* of the casing acts as a rudder to set the casing, which rotates on rollers 141, in the direction of the wind. For use as a water turbine the motor may be mounted on two sets of floats 63, 64, Fig. 9. When both sets of floats are filled with water, the apparatus sinks to the bed of the stream; when the upper set is emptied, the apparatus rises to its working position, while if both sets are emptied, the apparatus can be easily inspected and repaired. To empty the floats compressed air is forced in by a pump 76 operated by the turbine. To regulate the supply of motive fluid a series of pivoted shutter valves, hand or governor-controlled, may be provided in conjunction with the guide vanes. Such valves 115, Fig. 13, may also be provided to open additional exhaust apertures 112 in the turbine casing; if the control rods 116 are replaced by weights or springs, the valves act as automatic safety valves. Fig. 14 shows a roller shutter valve 131 wound on a cylinder and lifted against the tension of a spring by screws 135 actuated in the event of excessive wind pressure by wind-wheels 138. The endless chain 2 may be guided by rollers running in grooves in the casing, an example of a double conical roller 173 being shown in Fig. 19. Fig. 20 shows a chambered water turbine casing 202 anchored by a rope 210 and adapted to swing about and slide up and [illegible] 205

**No. 188,770. Turbines.**

*Summers, J. G., 441, 6th Street, San Diego, California, U.S.A. August 16, 1921. No. 21759. [Class 110 (iii.)*

In a turbine of the type having a rotor 24 with a sinuous channel 25 in its periphery to which motive fluid is supplied from nozzles 15, the channel 25 is bridged by cut-off plates 26 fitted on the rotor and serving to close the nozzles intermittently. The nozzles extend inwardly to an abutment 18 bearing on the periphery of the rotor. Spring-pressed rings 7 with a split at S prevent leakage of fluid. For reversing, an additional set of nozzles is provided. The exhaust passage 21 is located between the two sets of nozzles. The nozzles 15 are fitted with a screw thread for adjustment. The turbine may be compounded.

FIG. 1 FIG. 2

**No. 189,033. Furnaces.**

*Pohjanpalo, S., 1A3, Urhonkatu, Helsingfors, Finland. February 17, 1922, No. 4735. [Class 51 (i).]*

*Blast apparatus.* Between the blast pipe 1 and smoke stack 3 of a locomotive or other boiler, is arranged an intermediate pipe 2 having a corrugated surface so that the steam and gases issuing therefrom will have a larger contact surface with, and produce an increased suction on, the gases in the smoke-box. Two or more intermediate pipes such as 2 may be superposed.

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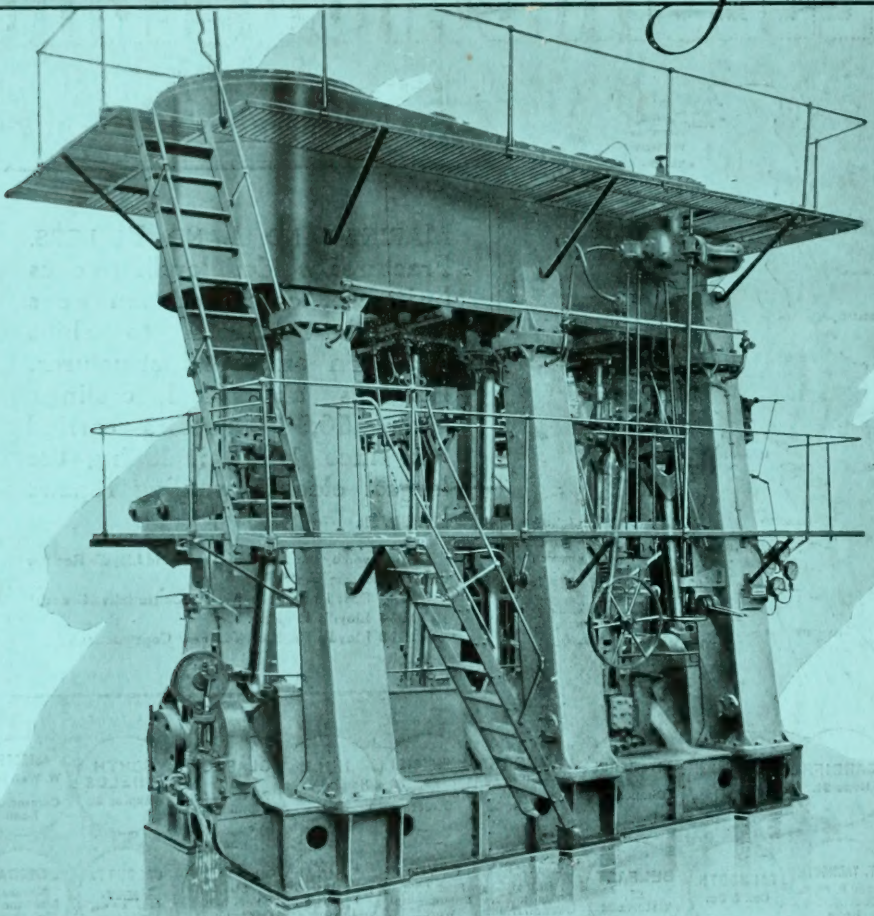

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